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Tests of water motors

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TESTS OF WATER MOTORS

BY

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ARTHUR OTTO SPIERLING

THESIS FOR THE DEGREE OF BACHELOR OF SCIENCE

IN MECHANICAL ENGINEERING

IN THE

COLLEGE OF ENGINEERING

OF THE

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May 31 1900

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY
Clarence Boyle Jr. and Arthur Otto Spierling

ENTITLED Tests of Water Motors

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE
DEGREE OF Bachelor of Science in Mechanical Engineering

H. L. Whittemore

Instructor in Charge.

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G. A. Goodenough

HEAD OF DEPARTMENT OF Mechanical Engineering



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TABLE OF CONTENTS

	Page
INTRODUCTION -----	1
HISTORY OF DEVELOPMENT OF WATER MOTORS.---	2
THEORETICAL CONSIDERATIONS -----	5
OUTLINE OF TESTS -----	6
PREPARATION FOR TESTS -----	8
METHOD OF CONDUCTING TESTS -----	11
DISCUSSION OF CALCULATIONS AND CURVES ---	13
DISCUSSION OF DATA -----	16
CONCLUSIONS -----	18
BIBLIOGRAPHY -----	21
PHOTOGRAPHS AND CUTS OF APPARATUS -----	25
MISCELLANEOUS DATA SHEETS AND CURVES ----	33
DATA SHEETS FOR DOBLE MOTOR -----	40
DATA SHEETS FOR PELTON MOTOR -----	80
EFFICIENCY CURVES FOR DOBLE MOTOR -----	100
EFFICIENCY CURVES FOR PELTON MOTOR -----	109
EFFICIENCY SURFACES FOR BOTH MOTORS -----	115

INTRODUCTION.

At this time, when the preservation of natural resources is of such general interest, it is but natural that the capitalist and engineer, as well as the general public, should turn to water power development. From the present rate at which fuel is being consumed, it is evident that some time in the future modern civilization will have to depend upon something more lasting than coal, oil or other fuels to supply the energy necessary to keep the wheels of progress in motion. From present indications the utilization of water power is the logical solution of the problem. For this reason it is hoped that a careful investigation of the performance of the Doble and Pelton Water Motors, two of the most popular and representative designs of the impulse type, will be of sufficient value to justify the acceptance of this thesis.

HISTORY OF THE DEVELOPMENT OF WATER MOTORS.

Water motors are by no means of recent invention, although all of the present refinements have been brought about within the last twenty-five or thirty years. Perhaps the earliest authentic record of a water wheel as applied to grinding corn is 85 B.C. Undoubtedly crude horizontal water wheels were known even before this date. Those of vertical design appear to have been known to the ancients at a very early period, being chiefly used to raise water for purposes of irrigation. Examples of such wheels in their original form and use are still to be seen on the Nile and the Euphrates.

For the sake of historical continuity, it may be mentioned that in 1581 a pump operated by a float wheel was established at London Bridge to supply the city of London with water. In 1675 an elaborate pumping plant driven by water wheels was established on the Seine River near St. Germain. In our own country one of the first applications of water power was the old tidal mill on Mill Creek, near Boston, constructed in 1631. This was followed by others and, in fact, availability of water power determined the location of the early settlement.

All of the wheels mentioned above, together with water wheels of more recent construction, may be divided into the three general classes:-

1. Gravity Wheels
2. Reaction Wheels
3. Impulse Wheels.

The first class includes the now seldom used undershot, overshot, and breast wheels; the second class is composed almost entirely of turbines; and the last includes the impulse water wheels upon which these tests were made.

The earliest scientific consideration of impulse wheels in this country was by Jearum Atkins who, apparently, anticipated the design of the wheels of the Girard type in Europe by his design of such a wheel in 1853. Atkin's first application for a patent was rejected, though one was finally granted in 1875. These patents are simply of historical interest as his inventions have had little effect on the practical development of this type of motor.

The impulse wheel found its earliest practical development in California, where the conditions for the development of power made such a wheel necessary.

The early tangential wheel, used on the Pacific Coast, was quite simple in construction, and the development of the buckets, which began with the simpler flat and curved forms, was very largely based on the experimental method used for the development of the reaction turbine in the East. Experiments were made at the University of California, by Mr. Ralph T. Brown, as early as 1883, and the resulting bulletin, published by the department was the earliest literature on tangential wheels published in this country.

Among the names connected with the early development of the tangential bucket, Pelton and Doble are very prominent. Daniel W. Mead in "Water Power Engineering" states that the most

extensive early development of the tangential wheel was by the Pelton Water Wheel Company whose work has been so widely known and used as to make the name "Pelton Wheel" a common title for all wheels of the tangential type.

THEORETICAL CONSIDERATIONS.

It is generally accepted that the losses of energy in an impulse wheel may be grouped as follows:-

1. Energy expended in heat due to the impact of the entering water against the buckets.
2. Energy expended in heat due to the friction of the water against the bucket surfaces.
3. Kinetic energy lost due to the velocity of the water leaving the buckets.

A well designed bucket will reduce all of these losses to a minimum. In order to accomplish this,

1. The bucket surface at the entrance should be approximately parallel to the relative course of the jet, and the bucket should be curved in such a manner as to avoid sharp angular deflections of the stream.

2. The number of buckets and therefore the wetted surface should be as small as will provide for the entire utilization of the jet, since friction is proportional to the wetted surface.

3. The discharge end of the bucket should be as nearly tangential to the wheel periphery as compatible with the clearance of the bucket which follows.

Bearing these essentials in mind, the illustrations of the buckets of both motors tested show that they are designed to fulfill these requirements.

OUTLINE OF TESTS.

These tests were made in order to determine the efficiency of the motors under different conditions which occur in practice. This efficiency is the ratio of the power output to the power input. This latter depends upon the amount of water supplied to the wheel and its head or pressure. Either of these could be varied independently so the following table of heads and orifice areas was chosen to cover the available range.

Doble Motor.		Pelton Motor.	
Effective Head (ft)	Area of Orifice (sq. in.)	Effective Head (ft)	Diameter of Orifice (inches)
10	.2;.3;.4;.5;.565	20	5/8;3/4;7/8;1
20	ditto	40	ditto
30	ditto	60	ditto
40	ditto	80	ditto
50	ditto	100	ditto
60	ditto		
80	ditto		
100	ditto		

This made eight series of tests on the Doble for the different increments of head, with five tests in each series for different valve openings, or a total of forty tests on the Doble. Smaller increments of head were taken for the lower values, due to the fact these heads could be obtained from a laboratory

stand pipe while for those above 50 feet it was necessary to connect with the pumping station. With the Pelton only the large increments of head were used, five series of tests being run under different heads with four tests in each series for the different nozzles available. This made a total of twenty tests run on the Pelton or sixty tests on the two motors.

PREPARATION FOR TESTS.

Before any tests were made both motors were thoroughly overhauled. The inlet casting on the Doble Motor, containing the needle valve, was removed from the apparatus and examined. As the area of the needle valve opening, or orifice, as it will hereafter be called, was in the shape of an annular ring, its area for any given position of needle valve was rather difficult to determine. After some consideration the following method of obtaining it was used and found satisfactory.

The diameter of the orifice was first measured. Readings were then taken for various positions of the needle of its diameter in the plane of the orifice. As the two values should be the same when closed or for zero turns of the valve, these measurements were easily checked and corrected. (See curves on page 34 .)

The net area of the orifice for different positions of the needle was merely the difference between the area of the orifice and that of the needle occupying the center of it. These values are tabulated on page 33, and the results shown by the curve on page 35 .

The next step was the calibration of the Measuring Pit E into which the tail race from both motors emptied. (See Fig. 7 , page 29.) Measurements showed the cross sectional area of this pit to be 50 square feet, and the calibration by means of known

weights, and therefore columns of water, checked this result so closely that this value was used throughout all the tests. (See Calibration Curve page 36). The Hook gage scale was also checked and found to be correct.

Two pressure gages were used; one for heads of fifty feet or less and the other for higher heads. Both were tested by means of the Crosby Dead Weight Tester and the hands adjusted so as to give accurate readings. Two sets of platform scales were also used, the smaller (as shown in Fig. 6 page 29) being used in connection with the Doble tests, where the weight on the scales never exceeded 65 pounds, and the larger scales (see Fig. 12 page 32) for the Pelton tests, where the net weight ran above 180 pounds. Both scales were tested and adjusted to read correctly.

Wooden prony brakes having comparatively long arms were available for each motor, but trial showed that the load on the scales was so small that there was likelihood of a large per cent error in reading the weight. For this reason, a rope prony brake having the shortest possible arm was used. As will be seen from the photographs of the apparatus, the rope was fastened to the base of the brake, given a turn around the pulley, and fastened to the threaded hook. The desired tension was accurately obtained by a fine pitch screw.

The gage recorded only the pressure head, while that used for each series of tests was effective head. A fundamental equation of Hydraulics, considering any section where all the readings are taken, is--

$$H = z + h + \frac{v^2}{2g}$$

where

H = Effective Head in feet.

Z = Elevation Head or distance between center of section and center of gage = 1.5 ft.

h = Pressure Head as recorded by gage in feet.

$\frac{v^2}{2g}$ = Velocity Head in Feet.

From the following calculations for the greatest discharge of both the 10 and 100 foot Doble Tests, it will be seen that the maximum velocity head was far below one percent of the effective head and so it could be neglected.

Inside diameter of pipe - 3 1/16 inches.

Inside area of pipe - .614 sq. ft.

Discharge -	10 ft.	Head -	.0805 cu. ft. per sec
	100 "	"	- .273 " " "
Velocity -	10 "	"	- .131 ft. per sec.
	100 "	"	- .445 " " "
Velocity Head -	10 "	"	- .00027 ft.
	100 "	"	- .00307 "
Percentage -	10 "	"	- .0027 per cent.
	100 "	"	- .00307 " " .

The values for the Pelton were about the same so the velocity head in all cases was disregarded.

The constant elevation head was allowed for by keeping the pressure recorded by the gage 1.5 feet below the desired effective head.

METHOD OF CONDUCTING TESTS.

The manner of carrying out the tests was extremely simple. For the Doble, the needle valve was set in the position to give the desired orifice area. The gate valve was then adjusted to give the required head which was held constant throughout the test by manipulating this valve. Values for the brake load were chosen so as to give about the desired increments of speed, care being taken that the smaller increments were taken in the region of maximum efficiency. This may be seen by reference to any of the efficiency curves following. Brake load and speed were recorded for about ten readings in each test, though their number was sometimes varied.

The exact moment at which the water reached a certain level fixed by the hook gage was noted at the beginning and end of each test. This determined the quantity discharged. The initial weight on the scales was found when the motor was stationary and there was no tension on the rope.

Tests were only run when the conditions were such that a constant head could be easily obtained with slight gate valve adjustments. The bearings were kept well oiled and the brake pulley was water cooled. All data was taken in duplicate to reduce possibility of loss.

For heads of over 50 feet, water from the University mains was used, and the higher reading pressure gage employed. Otherwise there was no change in conditions.

Tests on the Pelton were made exactly as above, except a different pair of platform scales was used.

DISCUSSION OF CALCULATIONS AND CURVES.

The following is an explanation of the various items on the data sheets. Tests were numbered from 1 D to 40 D, inclusive, for the Doble Motor, and from 1 P to 20 P, inclusive, for the Pelton Motor, the order being as indicated in the table on page 6 .

The date was put down in the order month, day, and year. The effective head and area of orifice were obtained as explained before. The Rise in pit was obtained from the direct readings on the hook gage scale, and the time in seconds calculated from the two readings of the moments at which the water broke over it. The initial weight on scales was obtained as explained before.

The discharge in cubic feet per second was found by multiplying the rise in pit (ft.) by the cross sectional area of the pit (50 sq. ft.) and dividing by the time (sec.). As there was more likelihood of error in obtaining these values than in securing any of the other data, these discharges were all checked. (See curves on pages 37, 38, and 39). With a constant head the discharge, of course, varies as the area of the orifice. This checked with the above mentioned curves. When values differed materially from those read from the curve, it was evident that an error in observation had been made, and so the curve value was used. It is interesting to note that these points not only fall remarkably close to a straight line for a given head, but that the relation between values for the same orifice area and

$R = \text{Lever arm (in.)} = \text{radius of pulley plus } 1/2$
 $\text{diameter of rope} = 4 + 1/4 = 4.125 \text{ inches}$

$N = \text{Speed in R.P.M. (See column two)}$

$W = \text{Net load on scales in pounds (See column four)}$

Both pulleys had the same radius so that the constant .0006545 remained the same.

The efficiency in per cent (See Column six) was obtained by dividing the brake horse power by the jet horse power and multiplying by 100.

Sample Calculations.

Test 1 D -

$$\text{Discharge} = \frac{.72 \times 50}{1270} = .02833 \text{ cu. ft. per sec.}$$

$$\text{Jet H.P.} = \frac{62.5 \times .02833 \times 10}{550} = .0322$$

Reading No. 1.

$$W = 15.12 - 12.75 = 2.38 \text{ lb.}$$

$$\text{B.H.P.} = .0006545 \times 62 \times 2.38 = .00964$$

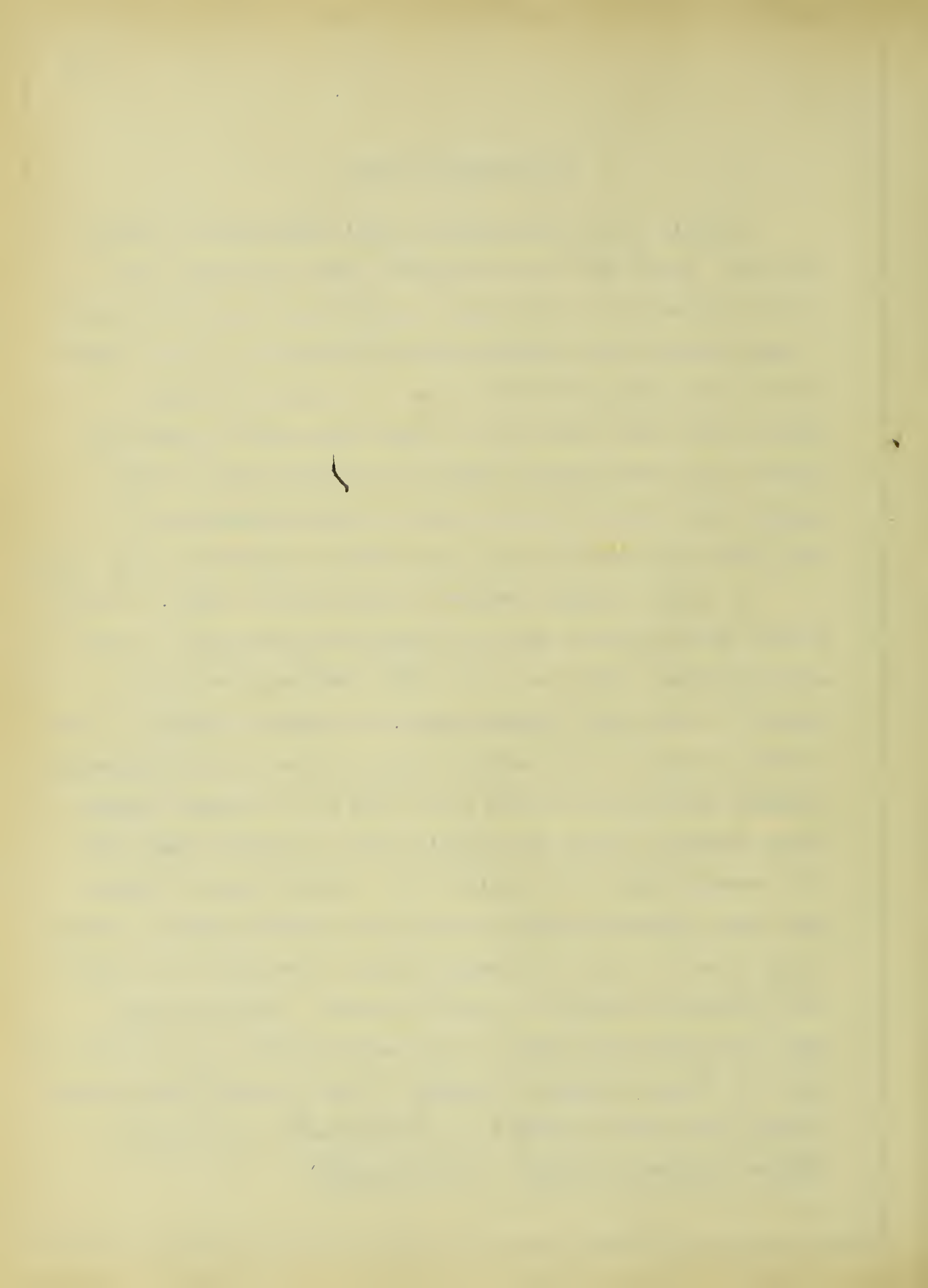
$$\text{Efficiency} = \frac{.00964 \times 100}{.0322} = 29.8 \text{ per cent.}$$

The curves were plotted between values of speed (R.P.M.) as abscissa and efficiency (per cent) as ordinates. A smooth curve was drawn thru as many points as possible so as to obtain average values. All curves of the same motor and under the same head were plotted on one page. The kind of points used for the different curves and the order in which they were numbered is shown by the key on pages 10Q-109.

DISCUSSION OF DATA.

In spite of all precautions slight experimental errors crept in. These were first noticeable when the curves were plotted between the revolutions per minute and the efficiencies. A large number of the points do not lie exactly upon the curves but are scattered upon either side. As explained before smooth curves were drawn thru as many experimental points as possible and were averaged thru the remaining points taking special care that the curves made no radical divergence in shape from the characteristic curve of the tangential water wheel.

In order to check farther the experimental error, a surface was plotted between the variables orifice area, motor efficiency, and effective head. This surface as was first plotted for the Doble 12-inch motor, is shown on page 115. The elements shown here are smooth curves but when the perpendicular elements were drawn in these were found to be somewhat jagged. These irregular curves were plotted upon a separate sheet and all irregularities were smoothed out. Another set of curves were then plotted between efficiency and orifice area by reading points from the above mentioned smoothed curves and the irregularities again removed in a similar manner. After plotting back and forth three times in this way, another surface was laid off which is shown on page 116. The surface for the Pelton 18-inch motor was obtained in a similar manner and only the "faired" surface is shown. (See page 118.)



The blue lines extending from the surface are merely imaginary lines for which no experimental data was obtained. The dotted curved lines represent those elements which would not be seen if the solid actually existed. Given the effective head and orifice area, the maximum efficiency of the motor may be found in the following manner. From the intersection of the head and area coordinates, draw a perpendicular to the XY plane until it intersects the surface. The length of this perpendicular gives the highest efficiency directly in per cent when laid off to the scale on the Z axis. For example with a 60 ft. head and .4 sq. in. orifice area, the intersection is "a" (See page 116) and the perpendicular is "ab" which when measured along the Z axis gives 66.5 percent.

CONCLUSIONS.

From the surface of the Doble 12-inch motor, shown on page 116, it is evident that the crest of maximum efficiencies travels from right to left as the effective head increases. Points on the crest of this wave were projected upon the X-Y plane and it was found that they lay practically upon a straight line. The equation of this line was determined and found to be:-

$$Y + 200X = 110$$

where Y = effective head (ft.)

X = area of orifice (sq. in.)

Knowing the available effective head, the area of orifice to be used for maximum efficiency may be easily found by substituting in the above equation the head for Y and solving for X . It is believed however, that this equation holds only within the limits of these tests. It is probable that as the head increases further than 60 ft., the line would commence to curve and would finally tend to become tangent to the Y or head axis.

The projected points of maximum efficiencies for the Doble motor have been compiled in the following table.

Effective Head (ft.)	Area of Orifice (sq. in.)	Efficiency (Per cent)
10	.5	73.5
20	.44	78.5
30	.41	81.5
40	.34	80.5
50	.3	79.5
60	.25	78.2
80	.225	73.5
100	.15	56.5

From this table, it is apparent that the Doble motor as installed in the University of Illinois Hydraulic Laboratory is most efficient when working under a 30 ft. head with an orifice area of .41 sq. in. It would also be economical to operate this wheel for heads ranging from 20 to 60 feet with the respective areas as above tabulated.

The low efficiencies obtained when under the higher heads, were due partly to the outlet of the wheel case being not large enough to prevent the tail water rising to the buckets. They were also due to the buckets being too small for the large discharge.

The crest of the surface showing the results of tests made upon the Pelton 18-inch motor page 118, is not so pronounced as that of the Doble motor, the surface being more flat. The crest is however perceptible traveling in directions from

a to b as the head increases.

The maximum efficiency obtained in the tests of the Pelton motor was 68.5 per cent when working under a head of 80 ft. and with an orifice area of .601 sq. in. (diameter = $7/8$). This value is low in comparison with the values obtained in the Doble motor tests and with the values usual for impulse wheels in general.

It is possible that the maximum efficiency of the Pelton 18-inch motor would occur at a higher head than those used in these tests. With such a few number of elements as were obtained for the surface shown on page 118 it would be impossible to prove conclusively that the maximum efficiency of the motor had been obtained. It would also be impracticable to deduce an expression from this surface, for obtaining the maximum efficiencies for the various heads.

The low efficiency found for the Pelton motor may be accounted for in the following manner. The buckets are cast integral with the web of the wheel and are made of such form as to be easily molded. In as much as the wheel has been in use for some years, the cast iron buckets have become rusty and no longer present a smooth surface to the action of the water. An appreciable amount of the energy of the water is therefore used up by friction in the buckets proper. If the bucket surfaces were polished, it would be expected that the efficiency would rise to at least 80 per cent. If it did not, a change in the design of the buckets would be advocated.

BIBLIOGRAPHY.

- Richards, John. Turbines Compared with Water Wheels.
Eng. News. Vol. 1, p. 530. 1892.
- Fox, William. Graphics of Water Wheels. Stevens Indicator.
Vol. 16, p. 30. 1899.
- Tangential Water Wheel Buckets. The Engr. May 1, 1904.
- Webber, Samuel. Turbine Testing.
Elec. Rev. Oct. 18, 1895, p. 477.
- Webber, Samuel. Instructions for Testing Turbines.
Eng. News, 1895. Vol. 2, p. 372.
- Cazin, F.M.F. The Efficiency of Water Wheels.
Elec. Wld. Jan. 9, 1897.
- Hitchcock, E.A. Impulse Water Wheel Experiments.
Elec. Wld. June 5, 1897.
- Thurston, R.H. Systematic Testing of Turbine Water Wheels in
the United States. Am. Soc. Mech. Eng. 1897,
p. 359.
- Efficiency Curves. Eng. News, 1903, Vol. 2, p. 312.
- Houston, W.C. Tests with a Pelton Wheel.
Mech. Engr. May 30, 1903.
- Henry, Geo. J., Jr. Tangential Water Wheel Efficiencies.
Am. Inst. Elec. Eng. Sept. 25, 1903.
- Crowell, H.C. and Lenth, G.C.D. An Investigation of the Double
Needle Regulating Nozzle. Thesis, Mass. Inst.
of Tech. 1903.

- LeConte, Joseph N. Efficiency Test of an Impulse Wheel.
Cal. Jour. of Tech. May, 1904.
- Webber, Wm. O. Efficiency Tests of Turbine Water Wheels.
Am. Soc. of Mech. Engrs., May, 1906.
- Westcott, A.L. Tests of a 12-inch Doble Water Wheel. Power,
Dec. 1907.
- Tyler, W.W. The Evolution of the American Type of Water
Wheel. Jour. Western Soc. Eng., Chicago, Vol.
3, 1898, pp. 879-901.
- Webber, Samuel. Ancient and Modern Water Wheels.
Eng. Mag., Vol. 1, 1891, pp. 324-331.
- Wright, Albert E. Current Wheels; Their Use in Lifting Water for
Irrigation. Bull. 146, Office of Experiment
Stations, U.S. Department of Agriculture.
- Atterberg, Gustaf. Theory for Turbine Water Wheels. Van Nos-
trand's Eng. Mag., Vol. 26, 1882, pp. 138-146,
230-238.
- Frizell, J.P. An Inquiry as to a More Perfect Form of Water
Wheel, Boston, 1897.
- Knight, Samuel N. Water Wheel Regulation. Jour. of Elec., Nov.,
1897.
- Williams, Harvey D. A New Method of Governing Water Wheels.
Sibley Jour. of Eng., March, 1896.
- Björling, Philip R. Water or Hydraulic Motors, pp. 40-53.
- Blair, F.K. The Efficiency of Pelton Water Wheels.
Elec. World, Sept. 12, 1896. Practical details
as to setting and connections.

- Bovey, Henry T. Treatise on Hydraulics. Reaction and Impulse Turbines, 1901, pp. 482-490.
- Cazin-Libby. Discussion on Impulse Turbines. Eng. News, Vol. 37, 1897, pp. 326-327, 395-~~396~~; Vol. 38, 1897, pp. 74-75.
- Doble, W.A. The Tangential Water Wheel. Trans. Am. Inst. Min. Eng., Vol. 29, 1899, pp. 852-894.
- Engineering News. The Pelton Water Wheel. Eng. News, Vol. 27, 1892, p. 172.
- Engineering News. Tests of New Impulse Water Wheel. Results of Tests of Hug Water Wheel. Eng. News, Vol. 40, 1898, p. 327.
- Groot, B.F. Experiments and Formula for the Efficiency of Tangential Water Wheels. Eng. News, Vol. 52, 1904, p. 430.
- Hatt, W. Kendrick. An Efficiency Surface for Pelton Motor. Jour. Franklin Inst., Vol. 143, 1897, pp. 455-461.
- Henry, G.J., Jr. Some Points in the Design of Buckets for Impulse Water Wheels. Eng. News, Vol. 50, 1903, pp. 322-324.
- Kingsford, R.T. A Complete Theory of Impulse Water Wheels and its Application to Their Design. Eng. News, Vol. 40, 1898, pp. 37-39.
- Franklin Institute. The Pelton Water Wheel. Jour. Franklin Inst., Vol. 140, 1895, pp. 161-197. (Report of the institute, through its committee on science and arts, on the invention of Lester A. Pelton.)

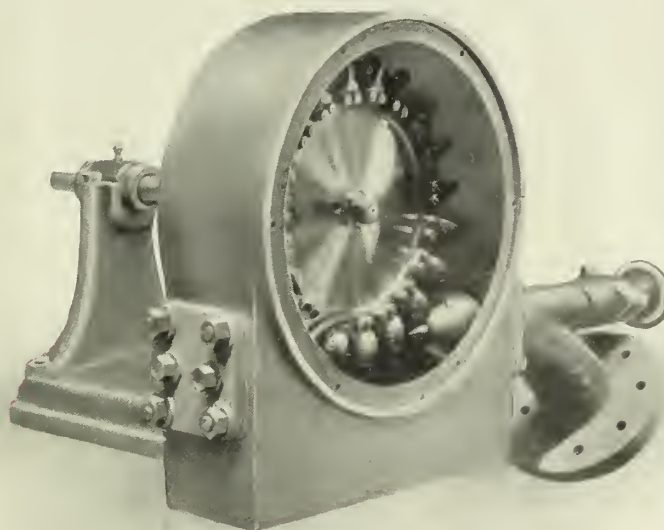
- Trinkham, Ralph R. and Kingdon, Justin T. Tests of Impulse Wheels at the University of Michigan. The Michigan Technic, Ann Arbor, 1906, pp. 26-102.
- Vigreux, Ch. Turbines. Paris, 1899, 141 - 154. (Discussion of rouets and Pelton Wheels).
- Horton, Robt. E. Turbine Water Wheel Tests and Power Tables. Dept. of Int., U.S. Geol. Survey. Water Supply and Irrigation. Paper No. 180. House Documents, Vol. 62.
- Mead, Daniel W. Water Power Engineering, pages 235-383.

PHOTOGRAPHS AND CUTS

Cuts from Doble and Pelton Catalogues.

LABORATORY WATER MOTOR

Fig. 1 shows a 12-inch Doble Water Motor designed especially for laboratory use, which we build for universities and technical colleges. This small machine is self-contained, and has the shaft extended far enough to carry a pulley or prony brake. The motor is provided with a Doble Needle Regulating Nozzle for hand



LABORATORY WATER MOTOR FOR TECHNICAL COLLEGES

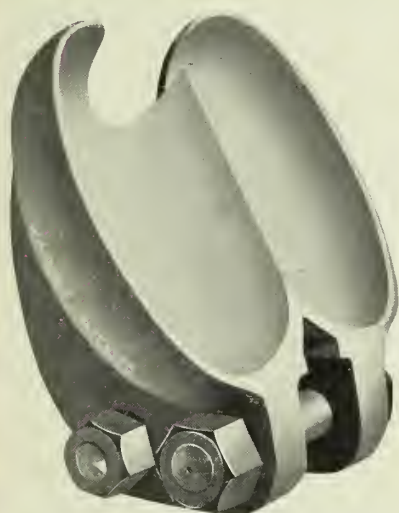
control, so that the jet of water may be varied to give the desired regulation in speed. The housing has plate-glass sides in order that the students may easily observe the water acting on, and discharging from, the buckets.

These little machines embody the best workmanship that can be turned out, and are designed and finished exactly upon the same lines as our largest machines, the buckets being formed of independent gun-metal castings, ground and polished on the hydraulic surfaces, and bolted to the wheel disc, each by two body-bound bolts fitted into reamed holes.

FIG. 1



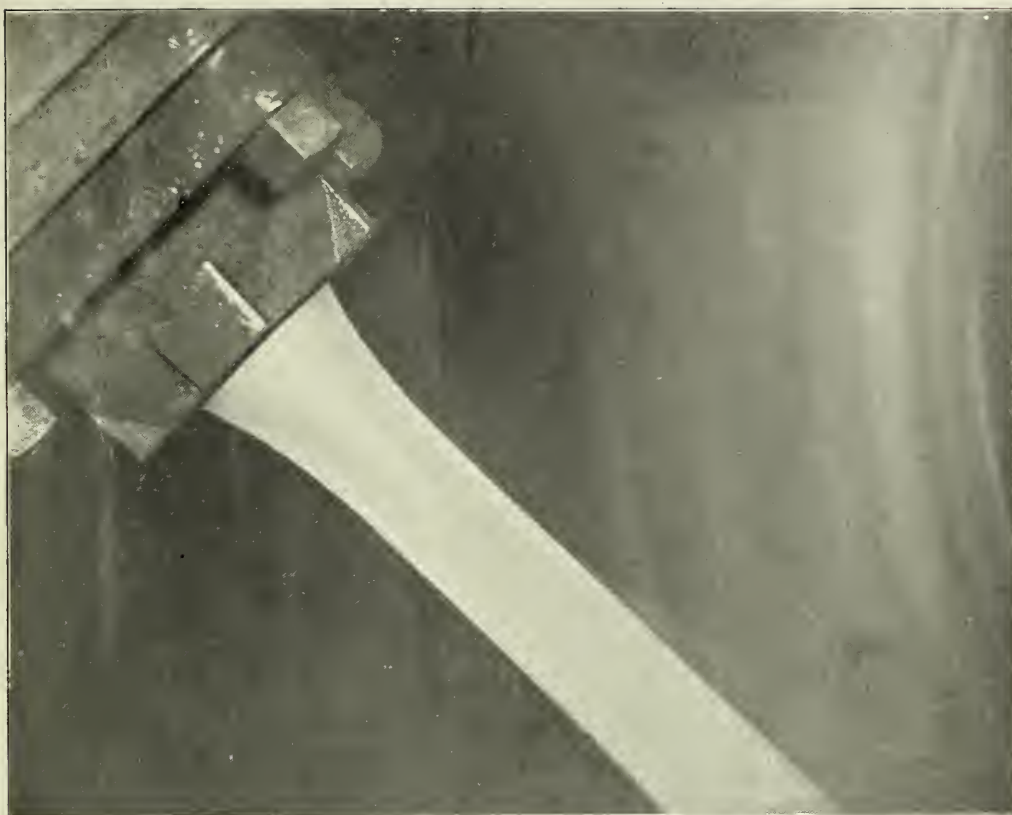
FIG. 2



DOBLE ELLIPSOIDAL BUCKET

DOBLE ELLIPSOIDAL BUCKET

FIG. 3



JET OF WATER FROM DOBLE NEEDLE REGULATING NOZZLE

FIG. 4



Tangential Wheel with Pelton Buckets

FIG. 5



FIG. 6 Rope Prony Brake and Scales



FIG. 7 Measuring Pit E

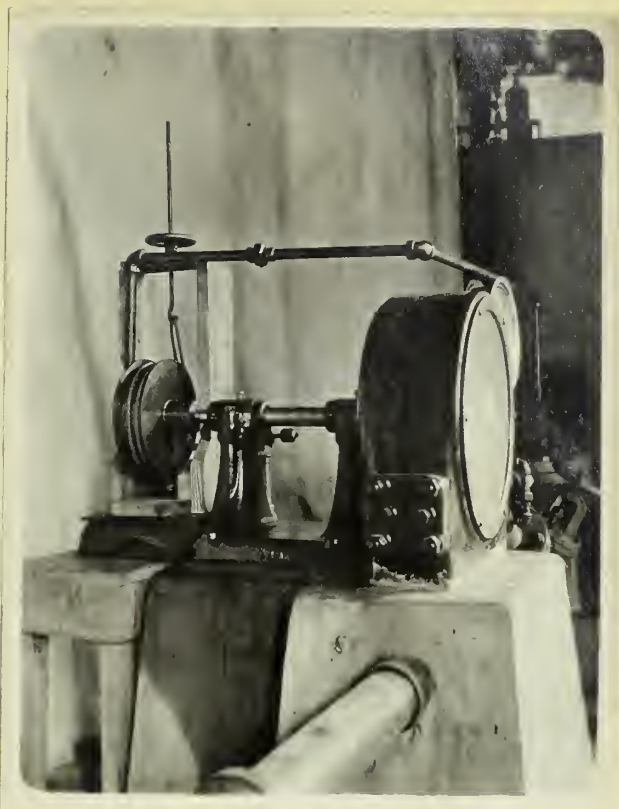


FIG. 8 DOBLE 12-INCH MOTOR

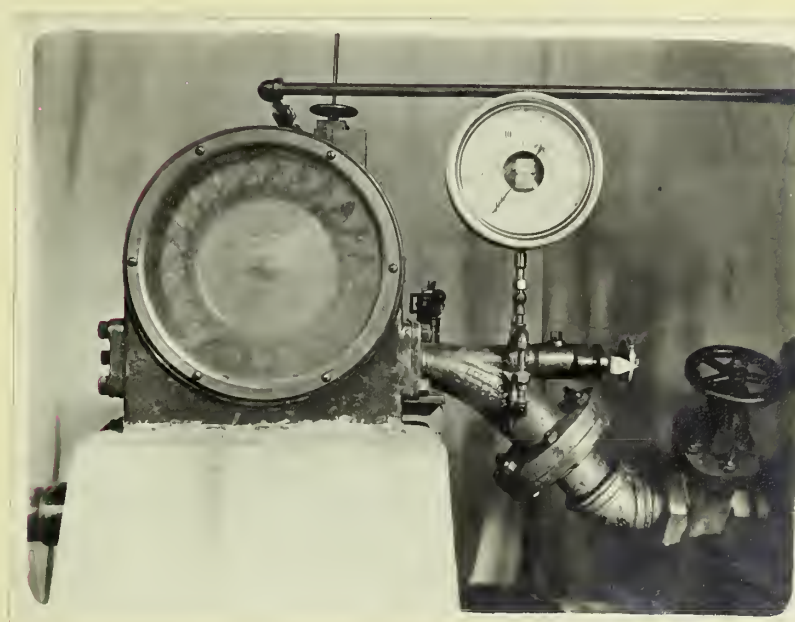


FIG. 9 DOBLE 12-INCH MOTOR

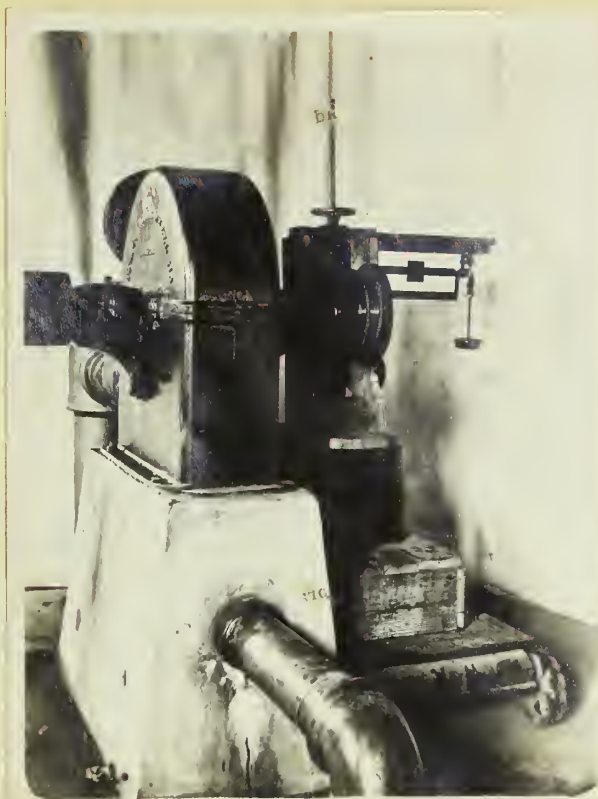


FIG. 10 PELTON 18-INCH MOTOR

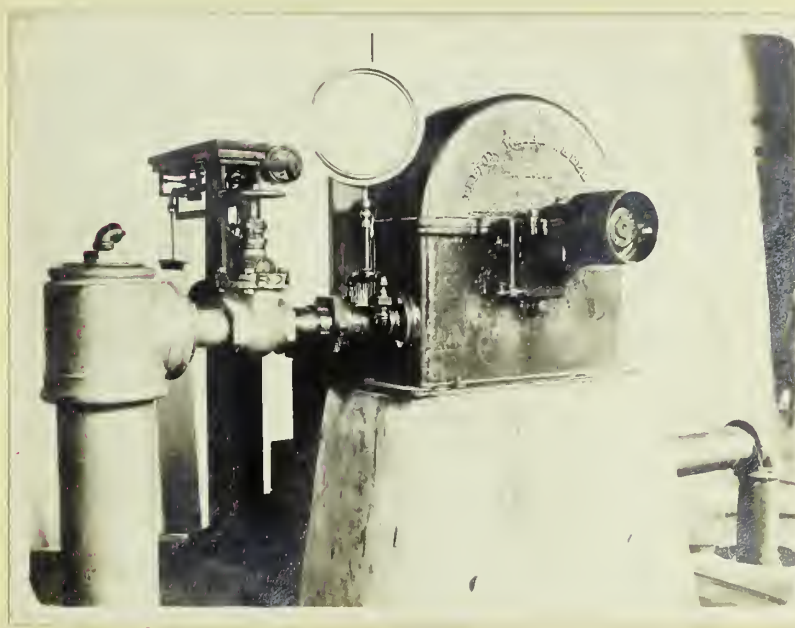


FIG. 11 PELTON 18-INCH MOTOR

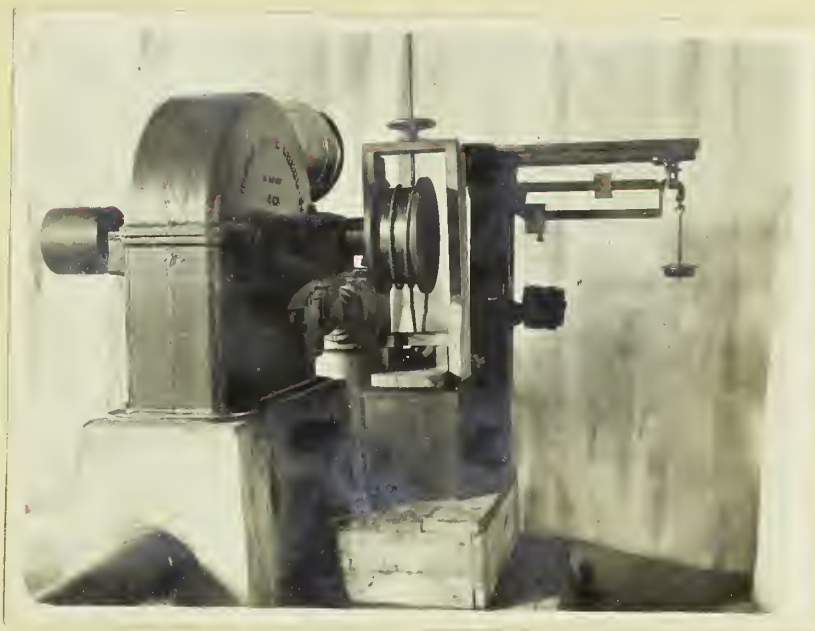


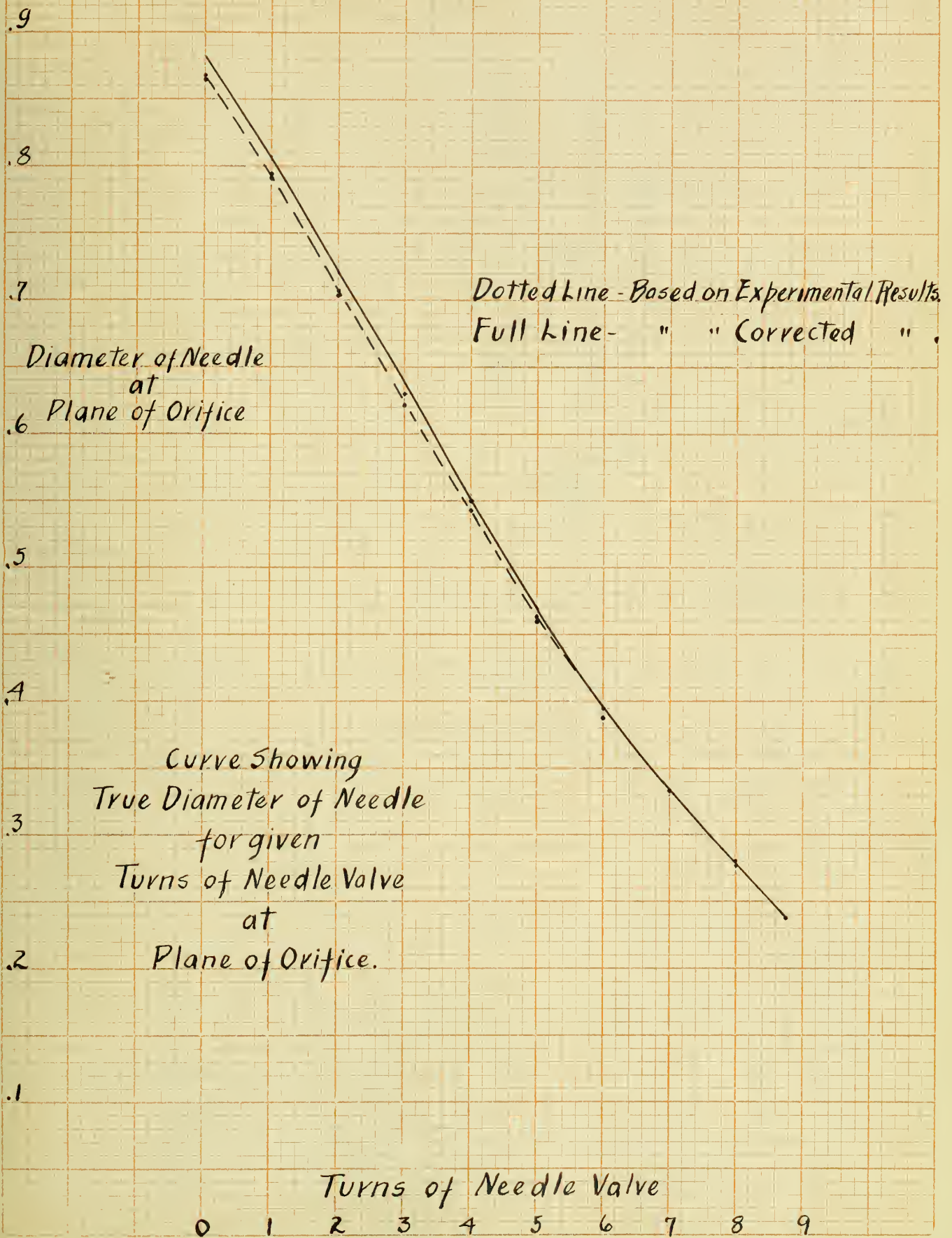
FIG. 12 PELTON 18-INCH MOTOR

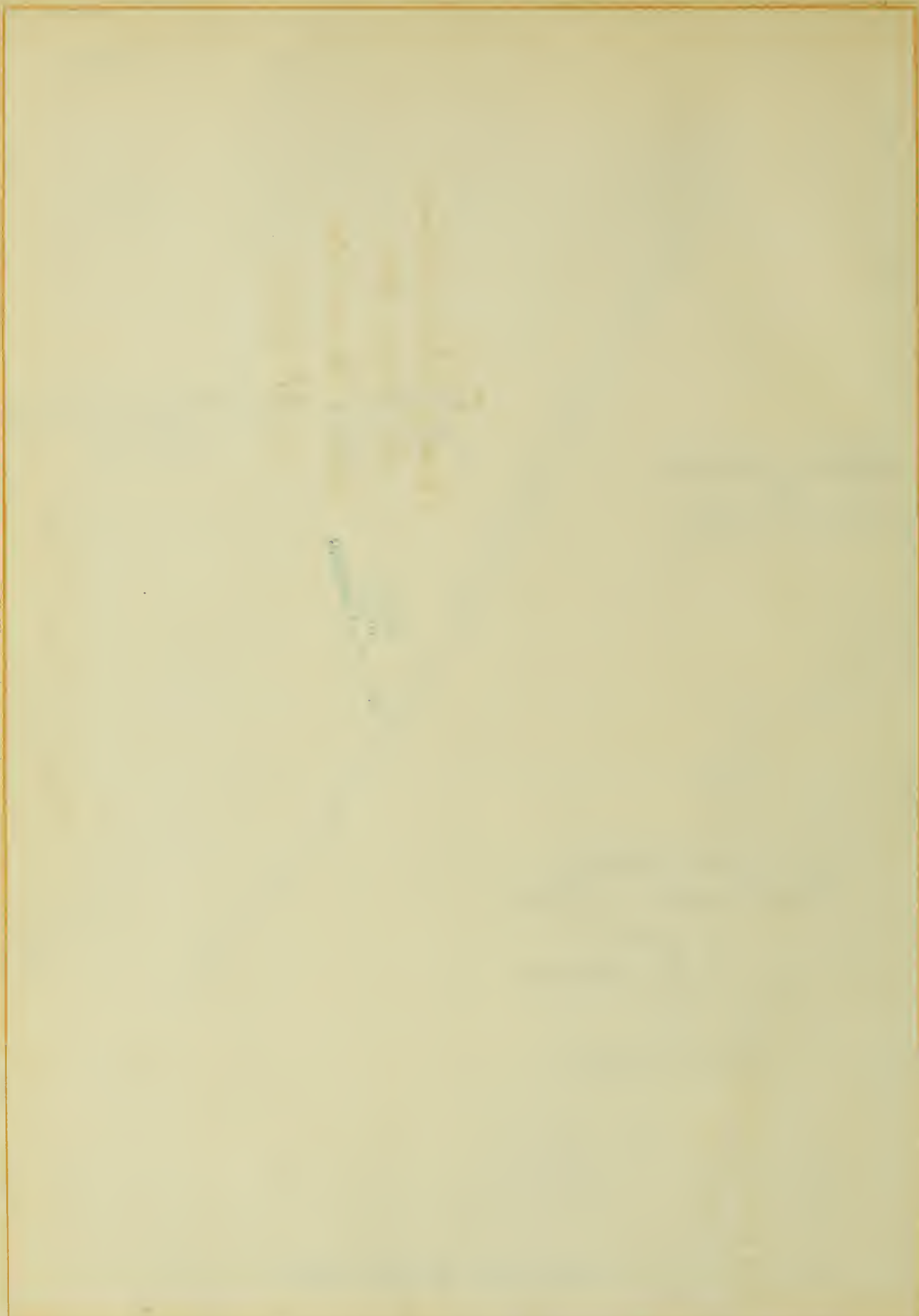
No. of Turns.	Diameter of Needle at Plane of Orifice-inches.			Area of Needle sq.in.	Net Area of Orifice sq.in.
	Trial-1.	Trial 2.	From Curve		
0	.865	.868	.882	.611	0
1	.794	.792	.807	.511	.100
2	.704	.704	.720	.407	.204
3	.630	.621	.638	.320	.291
4	.550	.544	.553	.240	.371
5	.460	.462	.470	.173	.438
6	.395	.389	.395	.123	.488
7	.334	.334	.330	.086	.525
8	.278	.280	.278	.061	.550
8.75	.239	.239	.239	.045	.565

Net Orifice Areas Used. sq.in	Corresponding Valve Turns No.
-------------------------------------	-------------------------------------

.2	1.97
.3	3.10
.4	4.40
.5	6.30
.565	8.75

Year	Month	Day	Time	Place	Remarks
1901	Jan	1	10:00	San Francisco	Left for New York
1901	Jan	2	11:00	New York	Arrived
1901	Jan	3	12:00	New York	Left for Boston
1901	Jan	4	13:00	Boston	Arrived
1901	Jan	5	14:00	Boston	Left for Philadelphia
1901	Jan	6	15:00	Philadelphia	Arrived
1901	Jan	7	16:00	Philadelphia	Left for Washington
1901	Jan	8	17:00	Washington	Arrived
1901	Jan	9	18:00	Washington	Left for Richmond
1901	Jan	10	19:00	Richmond	Arrived
1901	Jan	11	20:00	Richmond	Left for Norfolk
1901	Jan	12	21:00	Norfolk	Arrived
1901	Jan	13	22:00	Norfolk	Left for Portsmouth
1901	Jan	14	23:00	Portsmouth	Arrived
1901	Jan	15	24:00	Portsmouth	Left for London
1901	Jan	16	25:00	London	Arrived
1901	Jan	17	26:00	London	Left for Paris
1901	Jan	18	27:00	Paris	Arrived
1901	Jan	19	28:00	Paris	Left for Rome
1901	Jan	20	29:00	Rome	Arrived
1901	Jan	21	30:00	Rome	Left for Athens
1901	Jan	22	31:00	Athens	Arrived
1901	Jan	23	32:00	Athens	Left for Constantinople
1901	Jan	24	33:00	Constantinople	Arrived
1901	Jan	25	34:00	Constantinople	Left for Bagdad
1901	Jan	26	35:00	Bagdad	Arrived
1901	Jan	27	36:00	Bagdad	Left for Bombay
1901	Jan	28	37:00	Bombay	Arrived
1901	Jan	29	38:00	Bombay	Left for Calcutta
1901	Jan	30	39:00	Calcutta	Arrived
1901	Jan	31	40:00	Calcutta	Left for Singapore
1901	Jan	32	41:00	Singapore	Arrived
1901	Jan	33	42:00	Singapore	Left for Hong Kong
1901	Jan	34	43:00	Hong Kong	Arrived
1901	Jan	35	44:00	Hong Kong	Left for Shanghai
1901	Jan	36	45:00	Shanghai	Arrived
1901	Jan	37	46:00	Shanghai	Left for Yokohama
1901	Jan	38	47:00	Yokohama	Arrived
1901	Jan	39	48:00	Yokohama	Left for Kobe
1901	Jan	40	49:00	Kobe	Arrived
1901	Jan	41	50:00	Kobe	Left for Osaka
1901	Jan	42	51:00	Osaka	Arrived
1901	Jan	43	52:00	Osaka	Left for Kyoto
1901	Jan	44	53:00	Kyoto	Arrived
1901	Jan	45	54:00	Kyoto	Left for Nara
1901	Jan	46	55:00	Nara	Arrived
1901	Jan	47	56:00	Nara	Left for Uji
1901	Jan	48	57:00	Uji	Arrived
1901	Jan	49	58:00	Uji	Left for Kyoto
1901	Jan	50	59:00	Kyoto	Arrived
1901	Jan	51	60:00	Kyoto	Left for Osaka
1901	Jan	52	61:00	Osaka	Arrived
1901	Jan	53	62:00	Osaka	Left for Kobe
1901	Jan	54	63:00	Kobe	Arrived
1901	Jan	55	64:00	Kobe	Left for Yokohama
1901	Jan	56	65:00	Yokohama	Arrived
1901	Jan	57	66:00	Yokohama	Left for Shanghai
1901	Jan	58	67:00	Shanghai	Arrived
1901	Jan	59	68:00	Shanghai	Left for Hong Kong
1901	Jan	60	69:00	Hong Kong	Arrived
1901	Jan	61	70:00	Hong Kong	Left for Singapore
1901	Jan	62	71:00	Singapore	Arrived
1901	Jan	63	72:00	Singapore	Left for Calcutta
1901	Jan	64	73:00	Calcutta	Arrived
1901	Jan	65	74:00	Calcutta	Left for Bombay
1901	Jan	66	75:00	Bombay	Arrived
1901	Jan	67	76:00	Bombay	Left for Bagdad
1901	Jan	68	77:00	Bagdad	Arrived
1901	Jan	69	78:00	Bagdad	Left for Constantinople
1901	Jan	70	79:00	Constantinople	Arrived
1901	Jan	71	80:00	Constantinople	Left for Athens
1901	Jan	72	81:00	Athens	Arrived
1901	Jan	73	82:00	Athens	Left for Rome
1901	Jan	74	83:00	Rome	Arrived
1901	Jan	75	84:00	Rome	Left for Paris
1901	Jan	76	85:00	Paris	Arrived
1901	Jan	77	86:00	Paris	Left for London
1901	Jan	78	87:00	London	Arrived
1901	Jan	79	88:00	London	Left for New York
1901	Jan	80	89:00	New York	Arrived
1901	Jan	81	90:00	New York	Left for San Francisco
1901	Jan	82	91:00	San Francisco	Arrived
1901	Jan	83	92:00	San Francisco	Left for New York
1901	Jan	84	93:00	New York	Arrived
1901	Jan	85	94:00	New York	Left for Boston
1901	Jan	86	95:00	Boston	Arrived
1901	Jan	87	96:00	Boston	Left for Philadelphia
1901	Jan	88	97:00	Philadelphia	Arrived
1901	Jan	89	98:00	Philadelphia	Left for Washington
1901	Jan	90	99:00	Washington	Arrived
1901	Jan	91	100:00	Washington	Left for Richmond
1901	Jan	92	101:00	Richmond	Arrived
1901	Jan	93	102:00	Richmond	Left for Norfolk
1901	Jan	94	103:00	Norfolk	Arrived
1901	Jan	95	104:00	Norfolk	Left for Portsmouth
1901	Jan	96	105:00	Portsmouth	Arrived
1901	Jan	97	106:00	Portsmouth	Left for London
1901	Jan	98	107:00	London	Arrived
1901	Jan	99	108:00	London	Left for Paris
1901	Jan	100	109:00	Paris	Arrived
1901	Jan	101	110:00	Paris	Left for Rome
1901	Jan	102	111:00	Rome	Arrived
1901	Jan	103	112:00	Rome	Left for Athens
1901	Jan	104	113:00	Athens	Arrived
1901	Jan	105	114:00	Athens	Left for Constantinople
1901	Jan	106	115:00	Constantinople	Arrived
1901	Jan	107	116:00	Constantinople	Left for Bagdad
1901	Jan	108	117:00	Bagdad	Arrived
1901	Jan	109	118:00	Bagdad	Left for Bombay
1901	Jan	110	119:00	Bombay	Arrived
1901	Jan	111	120:00	Bombay	Left for Calcutta
1901	Jan	112	121:00	Calcutta	Arrived
1901	Jan	113	122:00	Calcutta	Left for Singapore
1901	Jan	114	123:00	Singapore	Arrived
1901	Jan	115	124:00	Singapore	Left for Hong Kong
1901	Jan	116	125:00	Hong Kong	Arrived
1901	Jan	117	126:00	Hong Kong	Left for Shanghai
1901	Jan	118	127:00	Shanghai	Arrived
1901	Jan	119	128:00	Shanghai	Left for Yokohama
1901	Jan	120	129:00	Yokohama	Arrived
1901	Jan	121	130:00	Yokohama	Left for Kobe
1901	Jan	122	131:00	Kobe	Arrived
1901	Jan	123	132:00	Kobe	Left for Osaka
1901	Jan	124	133:00	Osaka	Arrived
1901	Jan	125	134:00	Osaka	Left for Kyoto
1901	Jan	126	135:00	Kyoto	Arrived
1901	Jan	127	136:00	Kyoto	Left for Nara
1901	Jan	128	137:00	Nara	Arrived
1901	Jan	129	138:00	Nara	Left for Uji
1901	Jan	130	139:00	Uji	Arrived
1901	Jan	131	140:00	Uji	Left for Kyoto
1901	Jan	132	141:00	Kyoto	Arrived
1901	Jan	133	142:00	Kyoto	Left for Osaka
1901	Jan	134	143:00	Osaka	Arrived
1901	Jan	135	144:00	Osaka	Left for Kobe
1901	Jan	136	145:00	Kobe	Arrived
1901	Jan	137	146:00	Kobe	Left for Yokohama
1901	Jan	138	147:00	Yokohama	Arrived
1901	Jan	139	148:00	Yokohama	Left for Shanghai
1901	Jan	140	149:00	Shanghai	Arrived
1901	Jan	141	150:00	Shanghai	Left for Hong Kong
1901	Jan	142	151:00	Hong Kong	Arrived
1901	Jan	143	152:00	Hong Kong	Left for Singapore
1901	Jan	144	153:00	Singapore	Arrived
1901	Jan	145	154:00	Singapore	Left for Calcutta
1901	Jan	146	155:00	Calcutta	Arrived
1901	Jan	147	156:00	Calcutta	Left for Bombay
1901	Jan	148	157:00	Bombay	Arrived
1901	Jan	149	158:00	Bombay	Left for Bagdad
1901	Jan	150	159:00	Bagdad	Arrived
1901	Jan	151	160:00	Bagdad	Left for Constantinople
1901	Jan	152	161:00	Constantinople	Arrived
1901	Jan	153	162:00	Constantinople	Left for Athens
1901	Jan	154	163:00	Athens	Arrived
1901	Jan	155	164:00	Athens	Left for Rome
1901	Jan	156	165:00	Rome	Arrived
1901	Jan	157	166:00	Rome	Left for Paris
1901	Jan	158	167:00	Paris	Arrived
1901	Jan	159	168:00	Paris	Left for London
1901	Jan	160	169:00	London	Arrived
1901	Jan	161	170:00	London	Left for New York
1901	Jan	162	171:00	New York	Arrived
1901	Jan	163	172:00	New York	Left for San Francisco
1901	Jan	164	173:00	San Francisco	Arrived
1901	Jan	165	174:00	San Francisco	Left for New York
1901	Jan	166	175:00	New York	Arrived
1901	Jan	167	176:00	New York	Left for Boston
1901	Jan	168	177:00	Boston	Arrived
1901	Jan	169	178:00	Boston	Left for Philadelphia
1901	Jan	170	179:00	Philadelphia	Arrived
1901	Jan	171	180:00	Philadelphia	Left for Washington
1901	Jan	172	181:00	Washington	Arrived
1901	Jan	173	182:00	Washington	Left for Richmond
1901	Jan	174	183:00	Richmond	Arrived
1901	Jan	175	184:00	Richmond	Left for Norfolk
1901	Jan	176	185:00	Norfolk	Arrived
1901	Jan	177	186:00	Norfolk	Left for Portsmouth
1901	Jan	178	187:00	Portsmouth	Arrived
1901	Jan	179	188:00	Portsmouth	Left for London
1901	Jan	180	189:00	London	Arrived
1901	Jan	181	190:00	London	Left for Paris
1901	Jan	182	191:00	Paris	Arrived
1901	Jan	183	192:00	Paris	Left for Rome
1901	Jan	184	193:00	Rome	Arrived
1901	Jan	185	194:00	Rome	Left for Athens
1901	Jan	186	195:00	Athens	Arrived
1901	Jan	187	196:00	Athens	Left for Constantinople
1901	Jan	188	197:00	Constantinople	Arrived
1901	Jan	189	198:00	Constantinople	Left for Bagdad
1901	Jan	190	199:00	Bagdad	Arrived
1901	Jan	191	200:00	Bagdad	Left for Bombay
1901	Jan	192	201:00	Bombay	Arrived
1901	Jan	193	202:00	Bombay	Left for Calcutta
1901	Jan	194	203:00	Calcutta	Arrived
1901	Jan	195	204:00	Calcutta	Left for Singapore
1901	Jan	196	205:00	Singapore	Arrived
1901	Jan	197	206:00	Singapore	Left for Hong Kong
1901	Jan	198	207:00	Hong Kong	Arrived
1901	Jan	199	208:00	Hong Kong	Left for Shanghai
1901	Jan	200	209:00	Shanghai	Arrived
1901	Jan	201	210:00	Shanghai	Left for Yokohama
1901	Jan	202	211:00	Yokohama	Arrived
1901	Jan	203	212:00	Yokohama	Left for Kobe
1901	Jan	204	213:00	Kobe	Arrived
1901	Jan	205	214:00	Kobe	Left for Osaka
1901	Jan	206	215:00	Osaka	Arrived
1901	Jan	207	216:00	Osaka	Left for Kyoto
1901	Jan	208	217:00	Kyoto	Arrived
1901	Jan	209	218:00	Kyoto	Left for Nara
1901	Jan	210	219:00	Nara	Arrived
1901	Jan	211	220:00	Nara	Left for Uji
1901	Jan	212	221:00	Uji	Arrived
1901	Jan	213	222:00	Uji	Left for Kyoto
1901	Jan	214	223:00	Kyoto	Arrived
1901	Jan	215	224:00	Kyoto	Left for Osaka
1901	Jan	216	225:00	Osaka	Arrived
1901	Jan	217	226:00	Osaka	Left for Kobe
1901	Jan	218	227:00	Kobe	Arrived
1901	Jan	219	228:00	Kobe	Left for Yokohama
1901	Jan	220	229:00	Yokohama	Arrived
1901	Jan	221	230:00	Yokohama	Left for Shanghai
1901	Jan	222	231:00	Shanghai	Arrived
1901	Jan	223	232:00	Shanghai	Left for Hong Kong
1901	Jan	224	233:00	Hong Kong	Arrived
1901	Jan	225	234:00	Hong Kong	Left for Singapore
1901	Jan	226	235:00	Singapore	Arrived
1901	Jan	227	236:00	Singapore	Left for Calcutta
1901	Jan	228	237:00	Calcutta	Arrived
1901	Jan	229	238:00	Calcutta	Left for Bombay
1901					



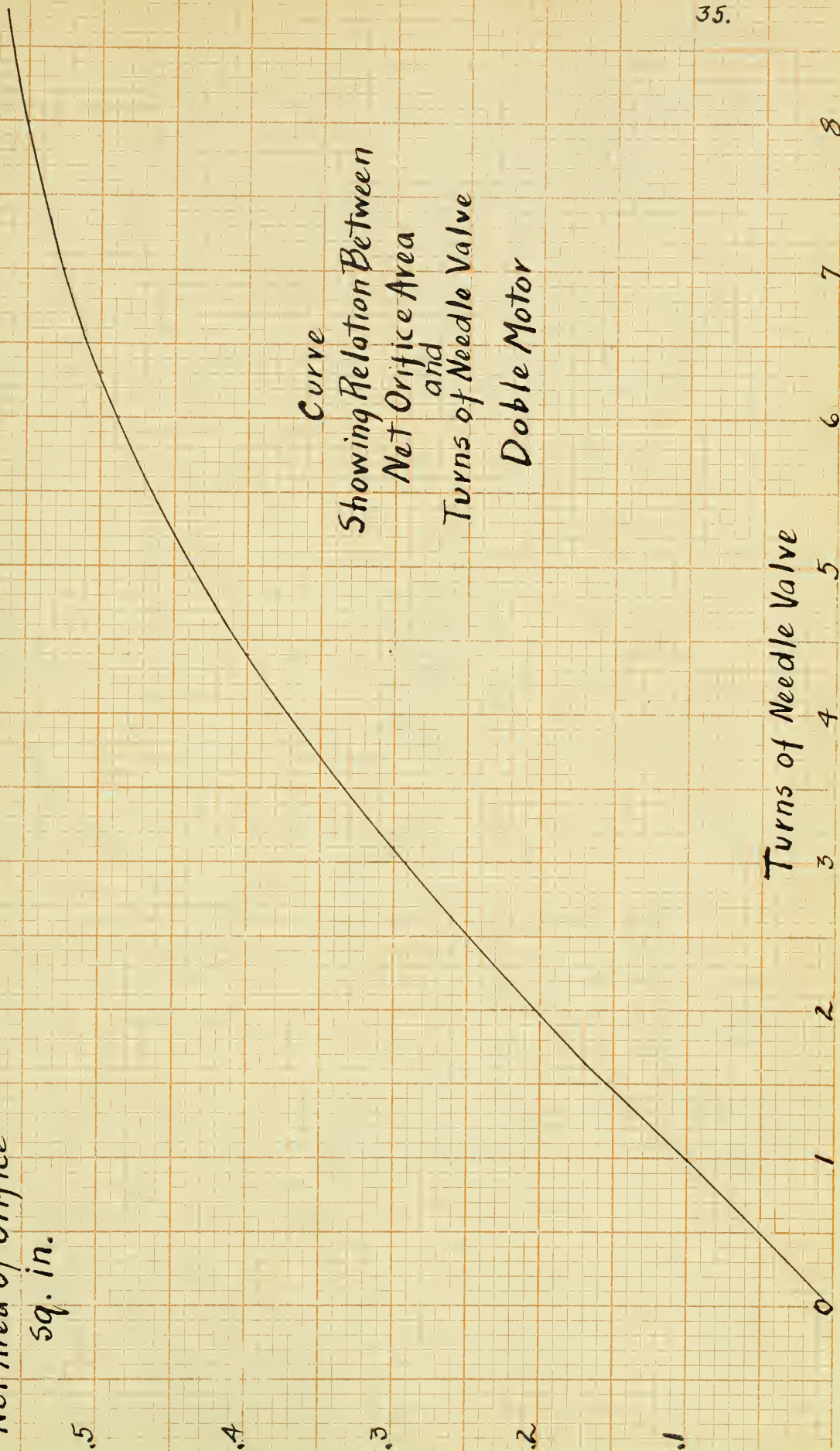


Net Area of Orifice
sq. in.

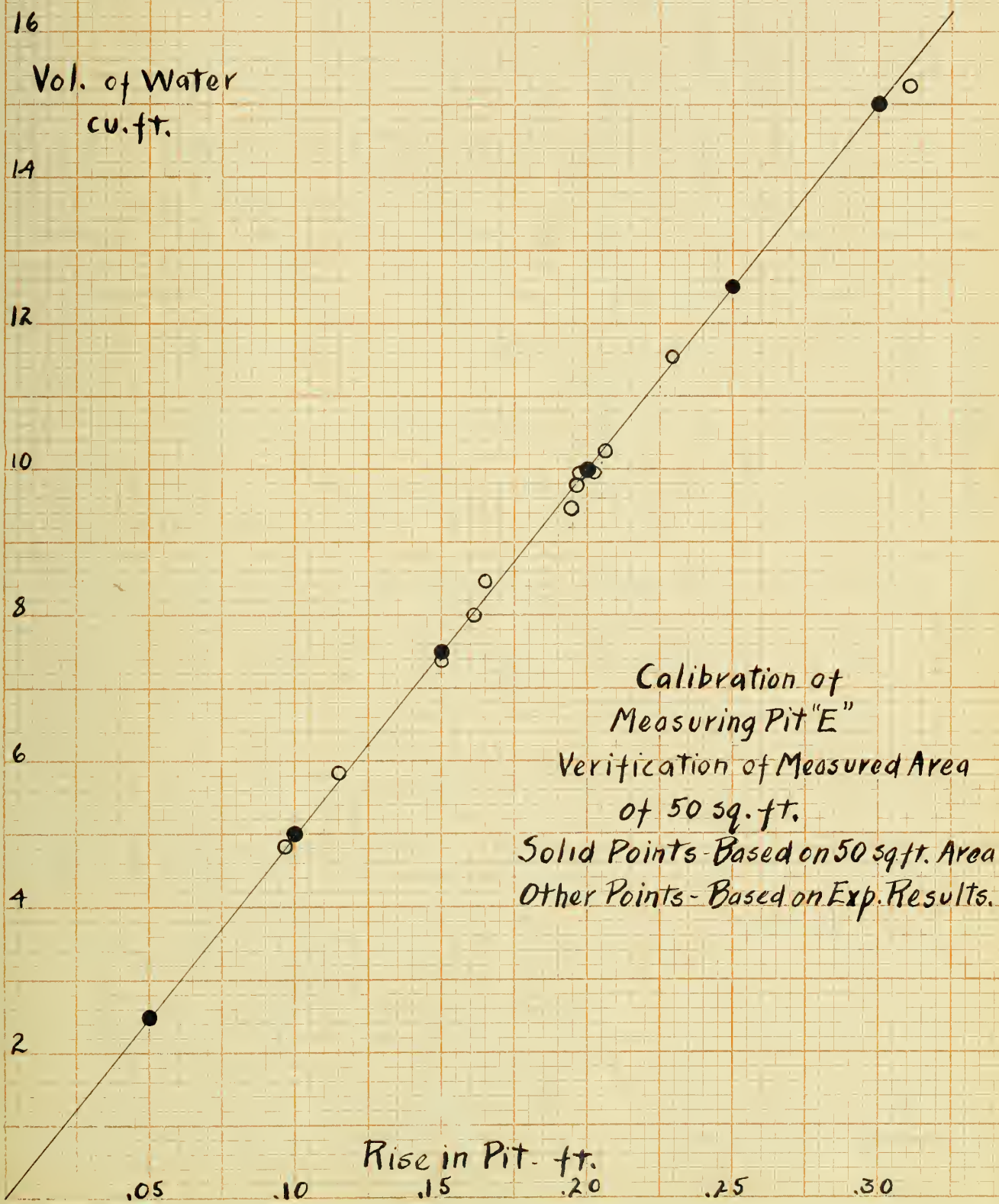
Curve
Showing Relation Between
Net Orifice Area
and
Turns of Needle Valve
Doble Motor

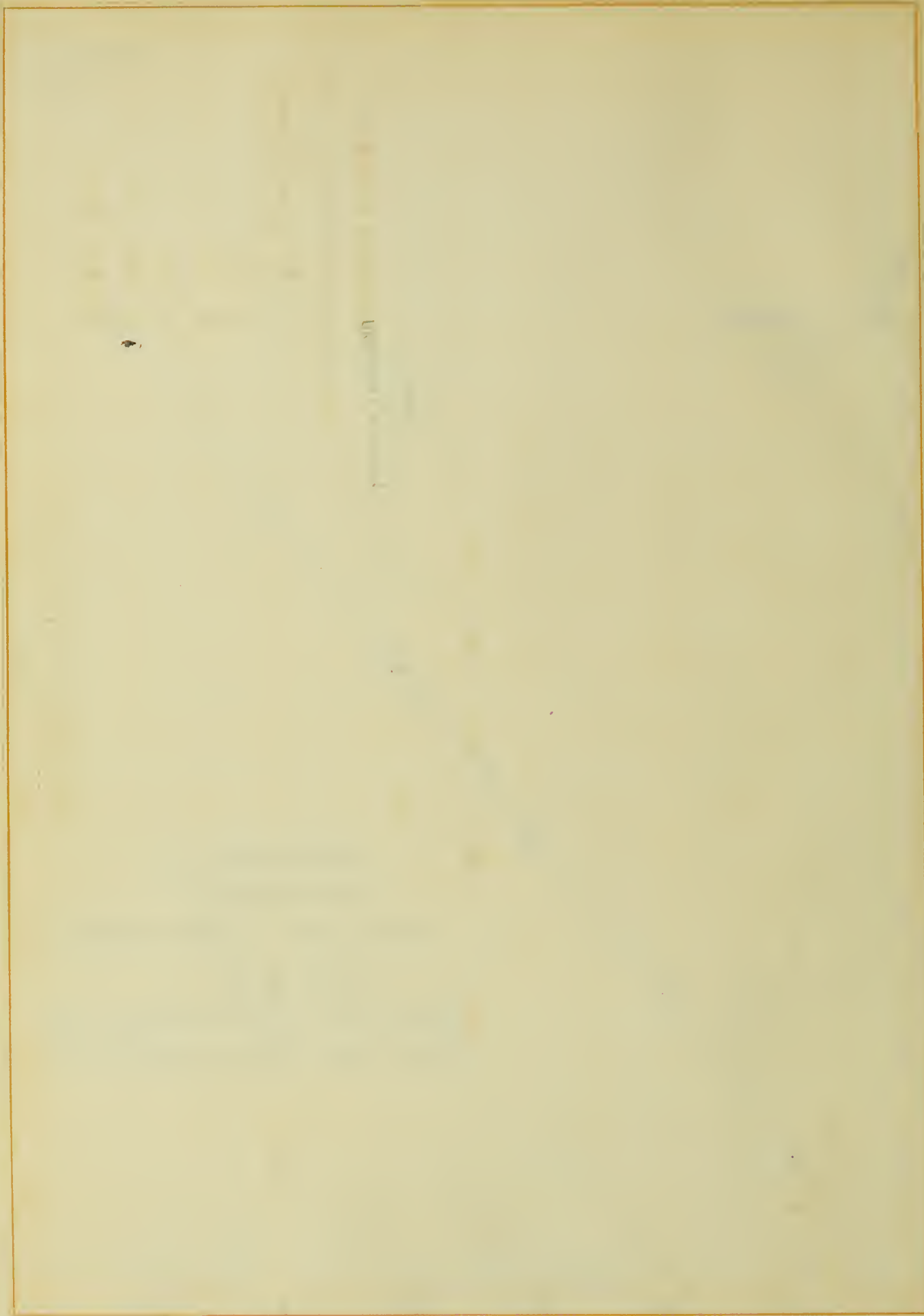
Turns of Needle Valve

0 1 2 3 4 5 6 7 8









Area of Orifice
sq. in.

.565

.5

.4

.3

.2

(a)

(b)

(c)

(d)

(e)

Relation Between
Area of Orifice and Discharge

(a) 10 foot Head.

(b) 20 "

(c) 30 "

(d) 40 "

(e) 50 "

Doble Motor.

Discharge - cu. ft. per sec.

.02

.04

.06

.08

.10

.12

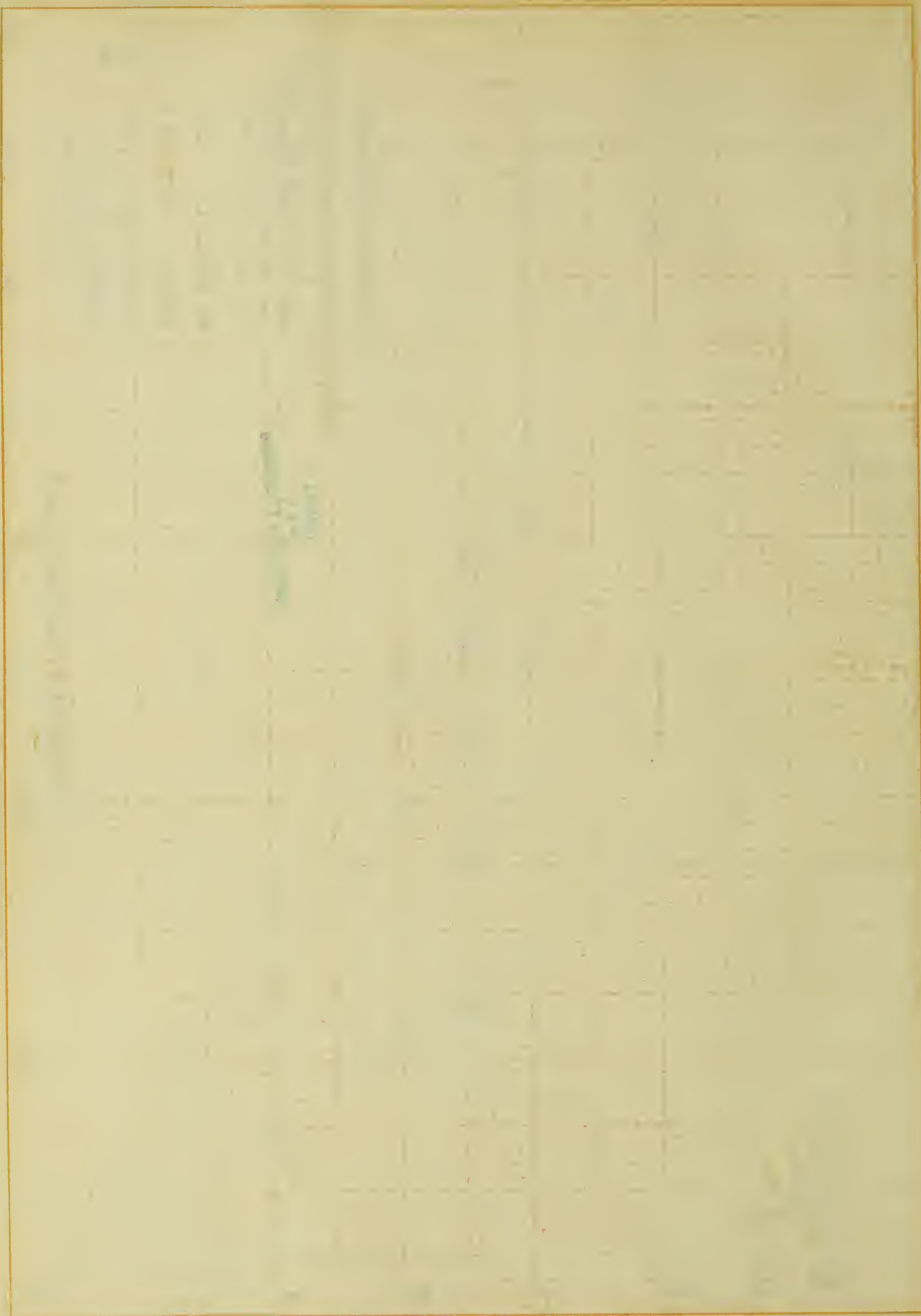
.14

.16

.18

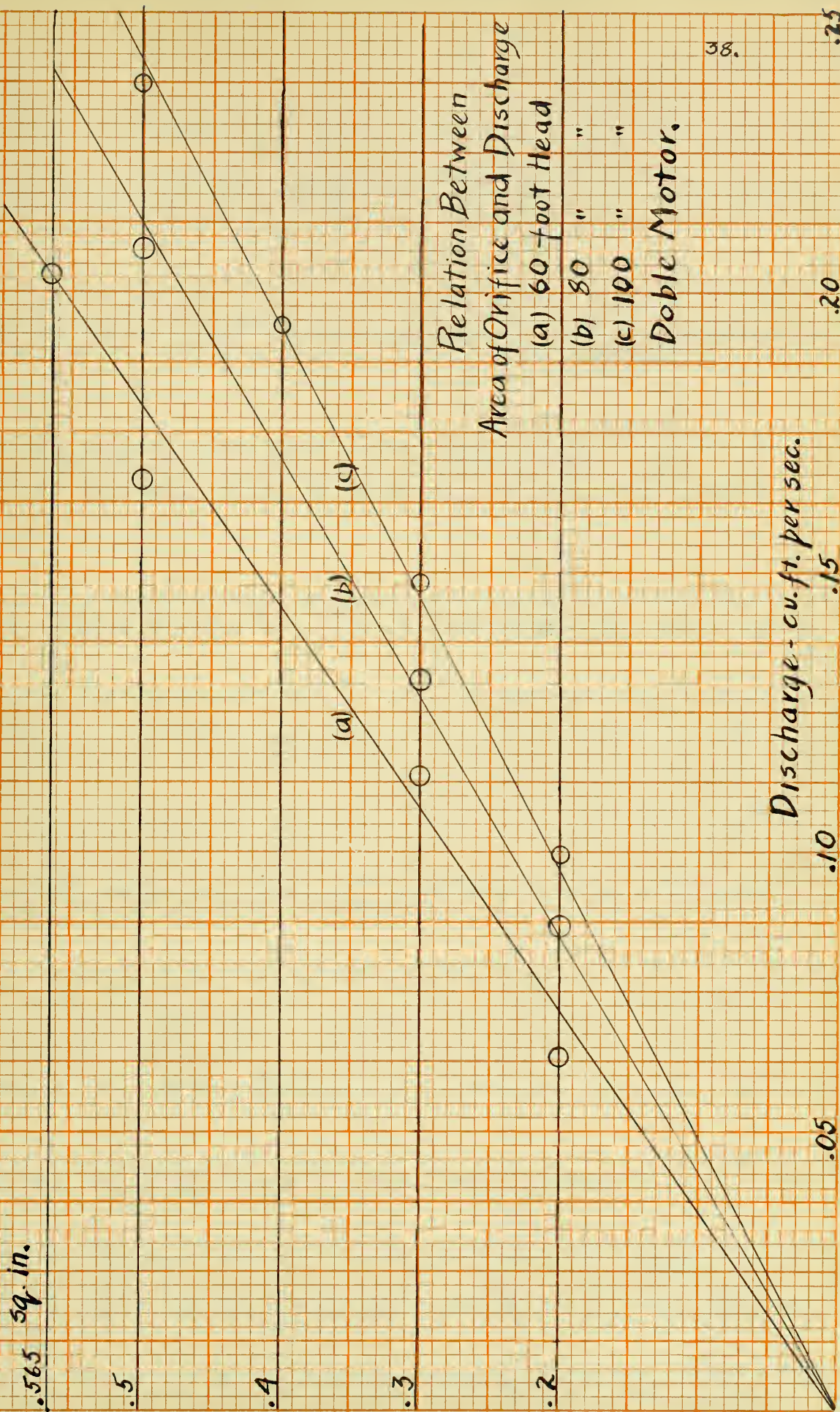
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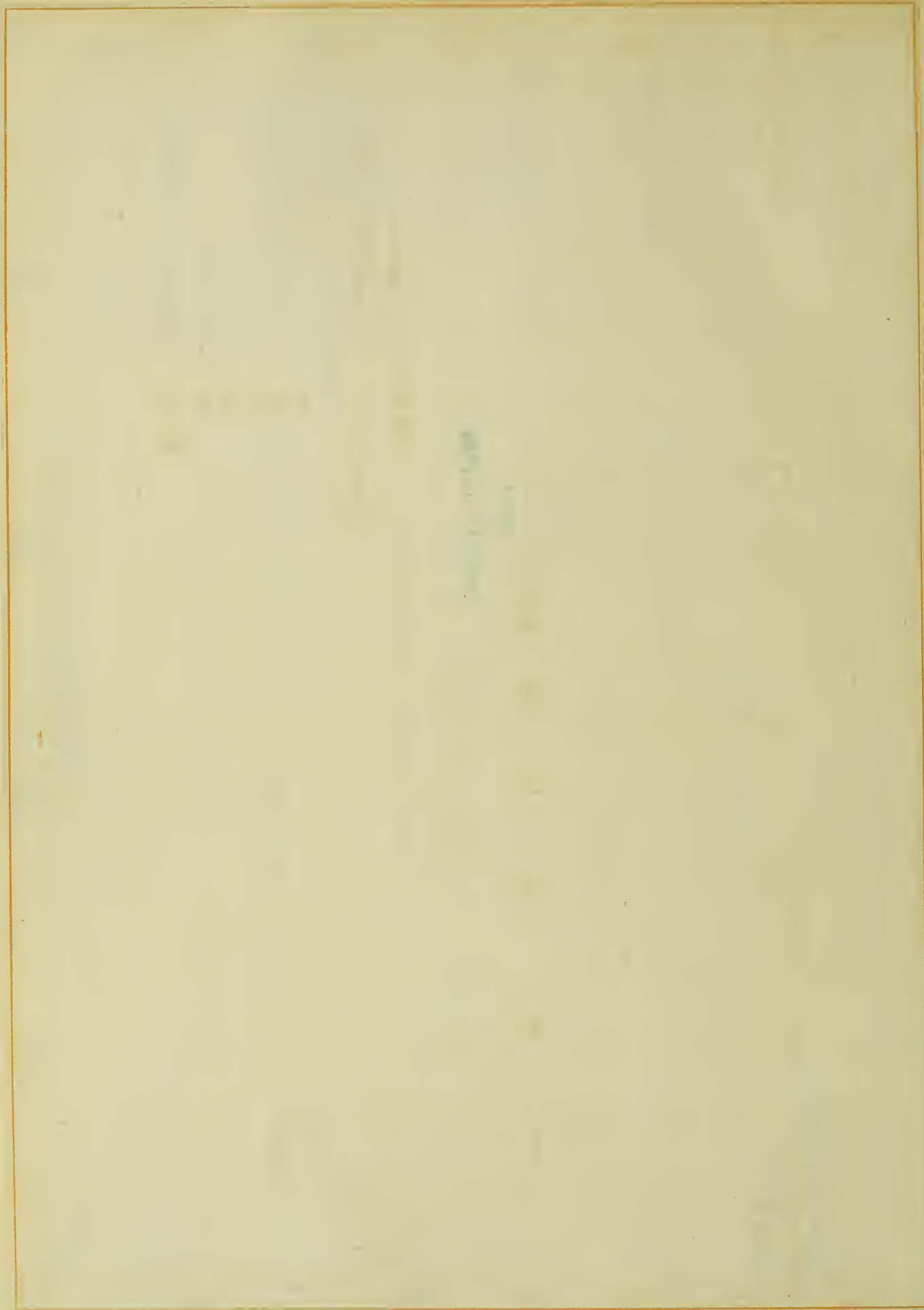
37.

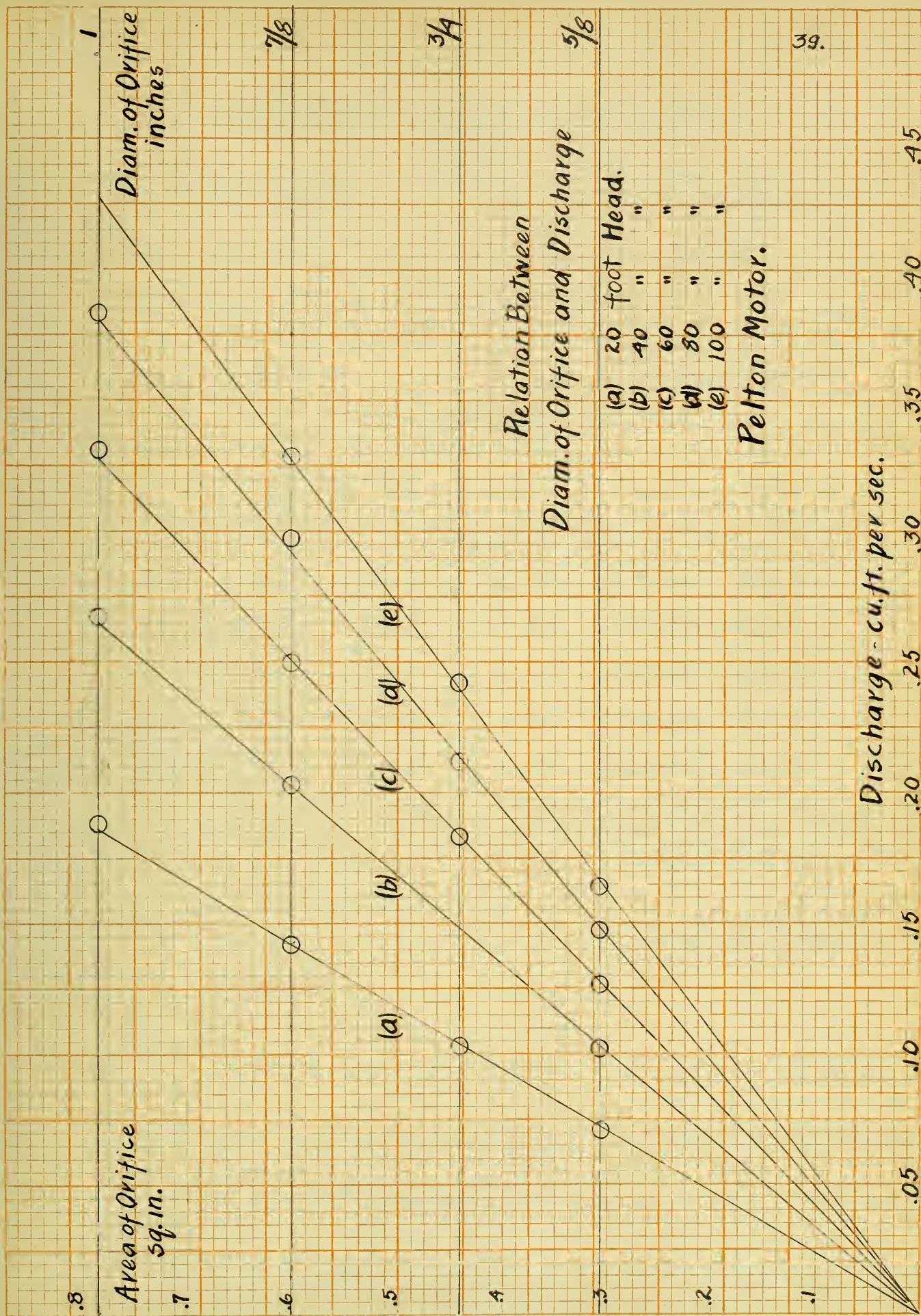


Area of Orifice

sq. in.







TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:.....*10*.....Date:.....*3/12/10*.....Effective Head (ft.):.....*10*.....Area of Orifice (sq. in.)*.2*.....Rise in Pit (ft.):*3.46-2.74=.72*..Initial Weight on Scales (lb.):.. *12.75*.....Time (sec.):*1270*.....Discharge (cu. ft. per sec.):.. *.02833*.....Jet H. P.:.. *.0322*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
-----	------------------------	--------------------------	----------------------	----------	-------------------------

<i>1</i>	<i>62</i>	<i>15.12</i>	<i>2.38</i>	<i>.00964</i>	<i>29.8</i>
<i>2</i>	<i>114</i>	<i>14.5</i>	<i>1.75</i>	<i>.01305</i>	<i>40.5</i>
<i>3</i>	<i>162</i>	<i>14.0</i>	<i>1.25</i>	<i>.01323</i>	<i>41.2</i>
<i>4</i>	<i>210</i>	<i>13.5</i>	<i>.75</i>	<i>.01025</i>	<i>31.8</i>
<i>5</i>	<i>245</i>	<i>13.0</i>	<i>.25</i>	<i>.00400</i>	<i>12.4</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*2 D*.....Date:....*3/12/10*.....Effective Head (ft.):....*10*.....Area of Orifice (sq. in.)*3*.....Rise in Pit (ft.):..*3.62 - 2.61 = 1.01*.....Initial Weight on Scales (lb.):..*12.75*...Time (sec.):*1190*.....Discharge (cu. ft. per sec.):..*0.4245*..Jet H. P. :..*0.482*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>45</i>	<i>16.5</i>	<i>3.75</i>	<i>.01103</i>	<i>22.9</i>
<i>2</i>	<i>86</i>	<i>16.0</i>	<i>3.25</i>	<i>.01829</i>	<i>37.9</i>
<i>3</i>	<i>119</i>	<i>15.5</i>	<i>2.75</i>	<i>.02140</i>	<i>44.4</i>
<i>4</i>	<i>160</i>	<i>15.0</i>	<i>2.25</i>	<i>.02357</i>	<i>48.8</i>
<i>5</i>	<i>186</i>	<i>14.5</i>	<i>1.75</i>	<i>.02130</i>	<i>44.2</i>
<i>6</i>	<i>218</i>	<i>14.0</i>	<i>1.25</i>	<i>.01783</i>	<i>37.0</i>
<i>7</i>	<i>266</i>	<i>13.5</i>	<i>.75</i>	<i>.01305</i>	<i>27.0</i>
<i>8</i>	<i>286</i>	<i>13.0</i>	<i>.25</i>	<i>.00468</i>	<i>9.7</i>

THEORY OF THE EARTH'S CRUST

CHAPTER I

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

1	2	3	4	5	6
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THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

THE EARTH'S CRUST

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *3 D*.....Date: *3/12/10*.....Effective Head (ft.): *10*.....Area of Orifice (sq. in.) *.4*.....Rise in Pit (ft.): *3.59 - 2.12 = 1.47*..Initial Weight on Scales (lb.): *12.75*...Time (sec.): *1305*.....Discharge (cu. ft. per sec.): *.0564*...Jet H. P.: *.0641*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	71	17.5	4.75	.02208	34.4
2	102	17.	4.25	.02840	44.3
3	135	16.5	3.75	.03315	51.6
4	160	16.	3.25	.03402	53.0
5	186	15.5	2.75	.03345	52.1
6	216	15.	2.25	.03180	49.6
7	241	14.5	1.75	.02760	43.0
8	258	14.	1.25	.02120	33.0
9	297	13.5	.75	.01460	22.8
10	312	13.	.25	.00511	7.9

TABLE OF CONTENTS

1. Introduction	1
2. Materials and Methods	2
3. Results	3
4. Discussion	4
5. Conclusion	5
6. References	6
7. Appendix	7
8. Index	8
9. Glossary	9
10. Acknowledgments	10
11. Funding	11
12. Author Contributions	12
13. Conflicts of Interest	13
14. Ethics Statement	14
15. Data Availability Statement	15
16. Supplementary Material	16
17. References	17
18. Index	18
19. Glossary	19
20. Acknowledgments	20
21. Funding	21
22. Author Contributions	22
23. Conflicts of Interest	23
24. Ethics Statement	24
25. Data Availability Statement	25
26. Supplementary Material	26
27. References	27
28. Index	28
29. Glossary	29
30. Acknowledgments	30
31. Funding	31
32. Author Contributions	32
33. Conflicts of Interest	33
34. Ethics Statement	34
35. Data Availability Statement	35
36. Supplementary Material	36
37. References	37
38. Index	38
39. Glossary	39
40. Acknowledgments	40
41. Funding	41
42. Author Contributions	42
43. Conflicts of Interest	43
44. Ethics Statement	44
45. Data Availability Statement	45
46. Supplementary Material	46
47. References	47
48. Index	48
49. Glossary	49
50. Acknowledgments	50
51. Funding	51
52. Author Contributions	52
53. Conflicts of Interest	53
54. Ethics Statement	54
55. Data Availability Statement	55
56. Supplementary Material	56
57. References	57
58. Index	58
59. Glossary	59
60. Acknowledgments	60
61. Funding	61
62. Author Contributions	62
63. Conflicts of Interest	63
64. Ethics Statement	64
65. Data Availability Statement	65
66. Supplementary Material	66
67. References	67
68. Index	68
69. Glossary	69
70. Acknowledgments	70
71. Funding	71
72. Author Contributions	72
73. Conflicts of Interest	73
74. Ethics Statement	74
75. Data Availability Statement	75
76. Supplementary Material	76
77. References	77
78. Index	78
79. Glossary	79
80. Acknowledgments	80
81. Funding	81
82. Author Contributions	82
83. Conflicts of Interest	83
84. Ethics Statement	84
85. Data Availability Statement	85
86. Supplementary Material	86
87. References	87
88. Index	88
89. Glossary	89
90. Acknowledgments	90
91. Funding	91
92. Author Contributions	92
93. Conflicts of Interest	93
94. Ethics Statement	94
95. Data Availability Statement	95
96. Supplementary Material	96
97. References	97
98. Index	98
99. Glossary	99
100. Acknowledgments	100
101. Funding	101
102. Author Contributions	102
103. Conflicts of Interest	103
104. Ethics Statement	104
105. Data Availability Statement	105
106. Supplementary Material	106
107. References	107
108. Index	108
109. Glossary	109
110. Acknowledgments	110
111. Funding	111
112. Author Contributions	112
113. Conflicts of Interest	113
114. Ethics Statement	114
115. Data Availability Statement	115
116. Supplementary Material	116
117. References	117
118. Index	118
119. Glossary	119
120. Acknowledgments	120
121. Funding	121
122. Author Contributions	122
123. Conflicts of Interest	123
124. Ethics Statement	124
125. Data Availability Statement	125
126. Supplementary Material	126
127. References	127
128. Index	128
129. Glossary	129
130. Acknowledgments	130
131. Funding	131
132. Author Contributions	132
133. Conflicts of Interest	133
134. Ethics Statement	134
135. Data Availability Statement	135
136. Supplementary Material	136
137. References	137
138. Index	138
139. Glossary	139
140. Acknowledgments	140
141. Funding	141
142. Author Contributions	142
143. Conflicts of Interest	143
144. Ethics Statement	144
145. Data Availability Statement	145
146. Supplementary Material	146
147. References	147
148. Index	148
149. Glossary	149
150. Acknowledgments	150
151. Funding	151
152. Author Contributions	152
153. Conflicts of Interest	153
154. Ethics Statement	154
155. Data Availability Statement	155
156. Supplementary Material	156
157. References	157
158. Index	158
159. Glossary	159
160. Acknowledgments	160
161. Funding	161
162. Author Contributions	162
163. Conflicts of Interest	163
164. Ethics Statement	164
165. Data Availability Statement	165
166. Supplementary Material	166
167. References	167
168. Index	168
169. Glossary	169
170. Acknowledgments	170
171. Funding	171
172. Author Contributions	172
173. Conflicts of Interest	173
174. Ethics Statement	174
175. Data Availability Statement	175
176. Supplementary Material	176
177. References	177
178. Index	178
179. Glossary	179
180. Acknowledgments	180
181. Funding	181
182. Author Contributions	182
183. Conflicts of Interest	183
184. Ethics Statement	184
185. Data Availability Statement	185
186. Supplementary Material	186
187. References	187
188. Index	188
189. Glossary	189
190. Acknowledgments	190
191. Funding	191
192. Author Contributions	192
193. Conflicts of Interest	193
194. Ethics Statement	194
195. Data Availability Statement	195
196. Supplementary Material	196
197. References	197
198. Index	198
199. Glossary	199
200. Acknowledgments	200
201. Funding	201
202. Author Contributions	202
203. Conflicts of Interest	203
204. Ethics Statement	204
205. Data Availability Statement	205
206. Supplementary Material	206
207. References	207
208. Index	208
209. Glossary	209
210. Acknowledgments	210
211. Funding	211
212. Author Contributions	212
213. Conflicts of Interest	213
214. Ethics Statement	214
215. Data Availability Statement	215
216. Supplementary Material	216
217. References	217
218. Index	218
219. Glossary	219
220. Acknowledgments	220
221. Funding	221
222. Author Contributions	222
223. Conflicts of Interest	223
224. Ethics Statement	224
225. Data Availability Statement	225
226. Supplementary Material	226
227. References	227
228. Index	228
229. Glossary	229
230. Acknowledgments	230
231. Funding	231
232. Author Contributions	232
233. Conflicts of Interest	233
234. Ethics Statement	234
235. Data Availability Statement	235
236. Supplementary Material	236
237. References	237
238. Index	238
239. Glossary	239
240. Acknowledgments	240
241. Funding	241
242. Author Contributions	242
243. Conflicts of Interest	243
244. Ethics Statement	244
245. Data Availability Statement	245
246. Supplementary Material	246
247. References	247
248. Index	248
249. Glossary	249
250. Acknowledgments	250
251. Funding	251
252. Author Contributions	252
253. Conflicts of Interest	253
254. Ethics Statement	254
255. Data Availability Statement	255
256. Supplementary Material	256
257. References	257
258. Index	258
259. Glossary	259
260. Acknowledgments	260
261. Funding	261
262. Author Contributions	262
263. Conflicts of Interest	263
264. Ethics Statement	264
265. Data Availability Statement	265
266. Supplementary Material	266
267. References	267
268. Index	268
269. Glossary	269
270. Acknowledgments	270
271. Funding	271
272. Author Contributions	272
273. Conflicts of Interest	273
274. Ethics Statement	274
275. Data Availability Statement	275
276. Supplementary Material	276
277. References	277
278. Index	278
279. Glossary	279
280. Acknowledgments	280
281. Funding	281
282. Author Contributions	282
283. Conflicts of Interest	283
284. Ethics Statement	284
285. Data Availability Statement	285
286. Supplementary Material	286
287. References	287
288. Index	288
289. Glossary	289
290. Acknowledgments	290
291. Funding	291
292. Author Contributions	292
293. Conflicts of Interest	293
294. Ethics Statement	294
295. Data Availability Statement	295
296. Supplementary Material	296
297. References	297
298. Index	298
299. Glossary	299
300. Acknowledgments	300
301. Funding	301
302. Author Contributions	302
303. Conflicts of Interest	303
304. Ethics Statement	304
305. Data Availability Statement	305
306. Supplementary Material	306
307. References	307
308. Index	308
309. Glossary	309
310. Acknowledgments	310
311. Funding	311
312. Author Contributions	312
313. Conflicts of Interest	313
314. Ethics Statement	314
315. Data Availability Statement	315
316. Supplementary Material	316
317. References	317
318. Index	318
319. Glossary	319
320. Acknowledgments	320
321. Funding	321
322. Author Contributions	322
323. Conflicts of Interest	323
324. Ethics Statement	324
325. Data Availability Statement	325
326. Supplementary Material	326
327. References	327
328. Index	328
329. Glossary	329
330. Acknowledgments	330
331. Funding	331
332. Author Contributions	332
333. Conflicts of Interest	333
334. Ethics Statement	334
335. Data Availability Statement	335
336. Supplementary Material	336
337. References	337
338. Index	338
339. Glossary	339
340. Acknowledgments	340
341. Funding	341
342. Author Contributions	342
343. Conflicts of Interest	343
344. Ethics Statement	344
345. Data Availability Statement	345
346. Supplementary Material	346
347. References	347
348. Index	348
349. Glossary	349
350. Acknowledgments	350
351. Funding	351
352. Author Contributions	352
353. Conflicts of Interest	353
354. Ethics Statement	354
355. Data Availability Statement	355
356. Supplementary Material	356
357. References	357
358. Index	358
359. Glossary	359
360. Acknowledgments	360
361. Funding	361
362. Author Contributions	362
363. Conflicts of Interest	363
364. Ethics Statement	364
365. Data Availability Statement	365
366. Supplementary Material	366
367. References	367
368. Index	368
369. Glossary	369
370. Acknowledgments	370
371. Funding	371
372. Author Contributions	372
373. Conflicts of Interest	373
374. Ethics Statement	374
375. Data Availability Statement	375
376. Supplementary Material	376
377. References	377
378. Index	378
379. Glossary	379
380. Acknowledgments	380
381. Funding	381
382. Author Contributions	382
383. Conflicts of Interest	383
384. Ethics Statement	384
385. Data Availability Statement	385
386. Supplementary Material	386
387. References	387
388. Index	388
389. Glossary	389
390. Acknowledgments	390
391. Funding	391
392. Author Contributions	392
393. Conflicts of Interest	393
394. Ethics Statement	394
395. Data Availability Statement	395
396. Supplementary Material	396
397. References	397
398. Index	398
399. Glossary	399
400. Acknowledgments	400
401. Funding	401
402. Author Contributions	402
403. Conflicts of Interest	403
404. Ethics Statement	404
405. Data Availability Statement	405
406. Supplementary Material	406
407. References	407
408. Index	408
409. Glossary	409
410. Acknowledgments	410
411. Funding	411
412. Author Contributions	412
413. Conflicts of Interest	413
414. Ethics Statement	414
415. Data Availability Statement	415
416. Supplementary Material	416
417. References	417
418. Index	418
419. Glossary	419
420. Acknowledgments	420
421. Funding	421
422. Author Contributions	422
423. Conflicts of Interest	423
424. Ethics Statement	424
425. Data Availability Statement	425
426. Supplementary Material	426
427. References	427
428. Index	428
429. Glossary	429
430. Acknowledgments	430
431. Funding	431
432. Author Contributions	432
433. Conflicts of Interest	433
434. Ethics Statement	434
435. Data Availability Statement	435
436. Supplementary Material	436
437. References	437
438. Index	438
439. Glossary	439
440. Acknowledgments	440
441. Funding	441
442. Author Contributions	442
443. Conflicts of Interest	443
444. Ethics Statement	444
445. Data Availability Statement	445
446. Supplementary Material	446
447. References	447
448. Index	448
449. Glossary	449
450. Acknowledgments	450
451. Funding	451
452. Author Contributions	452
453. Conflicts of Interest	453
454. Ethics Statement	454
455. Data Availability Statement	455
456. Supplementary Material	456
457. References	457
458. Index	458
459. Glossary	459
460. Acknowledgments	460
461. Funding	461
462. Author Contributions	462
463. Conflicts of Interest	463
464. Ethics Statement	464
465. Data Availability Statement	465
466. Supplementary Material	466
467. References	467
468. Index	468
469. Glossary	469
470. Acknowledgments	470
471. Funding	471
472. Author Contributions	472
473. Conflicts of Interest	473
474. Ethics Statement	474
475. Data Availability Statement	475
476. Supplementary Material	476
477. References	477
478. Index	478
479. Glossary	479
480. Acknowledgments	480
481. Funding	481
482. Author Contributions	482
483. Conflicts of Interest	483
484. Ethics Statement	484
485. Data Availability Statement	485
486. Supplementary Material	486
487. References	487
488. Index	488
489. Glossary	489
490. Acknowledgments	490
491. Funding	491
492. Author Contributions	492
493. Conflicts of Interest	493
494. Ethics Statement	494
495. Data Availability Statement	495
496. Supplementary Material	496
497. References	497
498. Index	498
499. Glossary	499
500. Acknowledgments	500
501. Funding	501
502. Author Contributions	502
503. Conflicts of Interest	503
504. Ethics Statement	504
505. Data Availability Statement	505
506. Supplementary Material	506
507. References	507
508. Index	508
509. Glossary	509
510. Acknowledgments	510
511. Funding	511
512. Author Contributions	512
513. Conflicts of Interest	513
514. Ethics Statement	514
515. Data Availability Statement	515
516. Supplementary Material	516
517. References	517
518. Index	518
519. Glossary	519
520. Acknowledgments	520
521. Funding	521
522. Author Contributions	522
523. Conflicts of Interest	523
524. Ethics Statement	524
525. Data Availability Statement	525
526. Supplementary Material	526
527. References	527
528. Index	528
529. Glossary	529
530. Acknowledgments	530
531. Funding	531
532. Author Contributions	532
533. Conflicts of Interest	533
534. Ethics Statement	534
535. Data Availability Statement	535
536. Supplementary Material	536
537. References	537
538. Index	538
539.	

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *4 D*.....Date: *3/12/10*.....Effective Head (ft.): *10*.....Area of Orifice (sq. in.) *5*.....Rise in Pit (ft.): *3.52 - 1.69 = 1.83*.....Initial Weight on Scales (lb.): *12.75*.....Time (sec.): *1270*.....Discharge (cu. ft. per sec.): *.07203*.....Jet H. P.: *.08195*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	55	19.	6.25	.02252	27.45
2	86	18.5	5.75	.0324	39.55
3	120	18.	5.25	.0412	50.3
4	138	17.5	4.75	.0428	52.4
5	166	17.	4.25	.0462	56.4
6	187	16.5	3.75	.04595	56.6
7	214	16.	3.25	.0455	55.8
8	231	15.5	2.75	.0416	50.8
9	239	15.	2.25	.0352	43.0
10	260	14.5	1.75	.02975	36.3
11	278	14.	1.25	.02275	27.7
12	306	13.5	.75	.01501	18.35
13	312	13.	.25	.00511	6.24

1910

1900

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*5 D*.....Date:....*3/19/10*.....Effective Head (ft.):....*10*.....Area of Orifice (sq. in.)*565*.....Rise in Pit (ft.):..*4.63-2.70=1.93*..Initial Weight on Scales (lb.):..*12.35*.....Time (sec.):*1300*.....Discharge (cu. ft. per sec.):..*0.805*.....Jet H. P. :..*0.915*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
-----	------------------------	--------------------------	----------------------	----------	-------------------------

1	118	18	5.65	.0436	47.6
2	144	17.5	5.15	.0485	53.0
3	150	17.25	4.90	.0481	52.6
4	161	17.	4.65	.0490	53.5
5	173	16.75	4.40	.0498	54.5
6	180	16.5	4.15	.0488	53.4
7	181	16.25	3.90	.0462	50.5
8	202	16.	3.65	.0482	52.7
9	240	15	2.65	.0416	45.5
10	318	13	.65	.0135	14.7

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:.....*6.D*.....

Date:.....*3/19/10*.....

Effective Head (ft.):.....*20*.....

Area of Orifice (sq. in.)*2*.....

Rise in Pit (ft.):...*Discharge*.....

Initial Weight on Scales (lb.):...*12.35*...

Time (sec.):...*read from curve*...

Discharge (cu. ft. per sec.):...*0.415*...

Jet H. P.:...*0.44*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
-----	------------------------	--------------------------	----------------------	----------	-------------------------

<i>1</i>	<i>115</i>	<i>18</i>	<i>5.65</i>	<i>.0425</i>	<i>45.0</i>
<i>2</i>	<i>190</i>	<i>17</i>	<i>4.65</i>	<i>.0578</i>	<i>61.2</i>
<i>3</i>	<i>234</i>	<i>16.5</i>	<i>4.15</i>	<i>.0635</i>	<i>67.2</i>
<i>4</i>	<i>246</i>	<i>16.25</i>	<i>3.90</i>	<i>.0628</i>	<i>66.5</i>
<i>5</i>	<i>262</i>	<i>16.</i>	<i>3.65</i>	<i>.0626</i>	<i>66.4</i>
<i>6</i>	<i>266</i>	<i>15.75</i>	<i>3.40</i>	<i>.0592</i>	<i>62.7</i>
<i>7</i>	<i>308</i>	<i>15.5</i>	<i>3.15</i>	<i>.0635</i>	<i>67.2</i>
<i>8</i>	<i>326</i>	<i>15.</i>	<i>2.65</i>	<i>.0566</i>	<i>60.0</i>
<i>9</i>	<i>404</i>	<i>14.</i>	<i>1.65</i>	<i>.0433</i>	<i>46.2</i>
<i>10</i>	<i>478</i>	<i>13.</i>	<i>.65</i>	<i>.0204</i>	<i>21.6</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:.....*7.D*.....Date:....*3/19/10*.....Effective Head (ft.):.....*20*.....Area of Orifice (sq. in.):*3*.....Rise in Pit (ft.):...*Discharge*...Initial Weight on Scales (lb.):...*12.35*...Time (sec.): *read from curve*..Discharge (cu. ft. per sec.):...:*0.62*.....Jet H. P.:*14.08*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>80</i>	<i>21.</i>	<i>8.65</i>	<i>.0453</i>	<i>32.2</i>
<i>2</i>	<i>212</i>	<i>19.</i>	<i>6.65</i>	<i>.0923</i>	<i>65.6</i>
<i>3</i>	<i>218</i>	<i>18.75</i>	<i>6.40</i>	<i>.0913</i>	<i>64.9</i>
<i>4</i>	<i>242</i>	<i>18.5</i>	<i>6.15</i>	<i>.0974</i>	<i>69.2</i>
<i>5</i>	<i>268</i>	<i>18.25</i>	<i>5.90</i>	<i>.1032</i>	<i>73.4</i>
<i>6</i>	<i>290</i>	<i>18.</i>	<i>5.65</i>	<i>.1072</i>	<i>76.3</i>
<i>7</i>	<i>296</i>	<i>17.75</i>	<i>5.40</i>	<i>.1048</i>	<i>74.4</i>
<i>8</i>	<i>290</i>	<i>17.5</i>	<i>5.15</i>	<i>.0977</i>	<i>69.5</i>
<i>9</i>	<i>309</i>	<i>17.25</i>	<i>4.90</i>	<i>.0991</i>	<i>70.5</i>
<i>10</i>	<i>378</i>	<i>16.</i>	<i>3.65</i>	<i>.0903</i>	<i>64.2</i>
<i>11</i>	<i>494</i>	<i>13.</i>	<i>.65</i>	<i>.0210</i>	<i>14.9</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *5 D*.....Date: *3/19/10*.....Effective Head (ft.): *20*.....Area of Orifice (sq. in.) *.4*.....Rise in Pit (ft.): *4.67 - 2.35 = 2.32*Initial Weight on Scales (lb.): *12.35*.....Time (sec.): *14.00*.....Discharge (cu. ft. per sec.): *.0829*.....Jet H. P.: *.1882*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	71	24	11.65	.0541	28.7
2	197	21.5	9.15	.1180	62.7
3	246	20.5	8.15	.1311	69.6
4	260	20.25	7.90	.1345	71.4
5	280	20.00	7.65	.1400	74.4
6	289	19.75	7.40	.1400	74.4
7	294	19.50	7.15	.1379	73.2
8	300	19.25	6.90	.1359	72.1
9	314	19.00	6.65	.1369	72.6
10	380	17.00	4.65	.1157	61.4
11	494	13.00	.65	.0210	11.1

2014年12月15日

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TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:.....*9 D*.....Date:.....*3/19/10*.....Effective Head (ft.):.....*20*.....Area of Orifice (sq. in.)*5*.....Rise in Pit (ft.):..*4.74-1.77=2.97*..Initial Weight on Scales (lb.):..*12.35*...Time (sec.):*1.450*.....Discharge (cu. ft. per sec.):..*.1022*...Jet H. P.:..*2324*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	74	26	13.65	.0706	30.4
2	164	24	11.65	.1250	53.7
3	236	22.5	10.15	.1567	67.4
4	252	22.25	9.90	.1631	70.2
5	265	22.	9.65	.1671	71.9
6	280	21.75	9.40	.1720	73.9
7	280	21.5	9.15	.1678	72.0
8	294	21.25	8.90	.1711	73.6
9	309	20.75	8.40	.1699	72.9
10	424	17.	4.65	.1289	55.4
11	516	13.	.65	.0220	9.4

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: ... 10. D.

Date: ... 3/19/10.

Effective Head (ft.): ... 2.0.

Area of Orifice (sq. in.) ... 565.

Rise in Pit (ft.): ... 4.53 - 1.25 = 3.28.

Initial Weight on Scales (lb.): ... 12.35.

Time (sec.): ... 13.95.

Discharge (cu. ft. per sec.): ... 1.175.

Jet H. P. ... 267.

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	108	27.	14.65	.1035	38.8
2	157	26	13.65	.1408	52.6
3	234	24	11.65	.1784	66.8
4	244	23.75	11.4	.1820	68.1
5	248	23.5	11.15	.1810	67.7
6	260	23.25	10.9	.1855	69.4
7	260	23	10.65	.1815	68.0
8	274	22.75	10.4	.1865	69.8
9	290	22	9.65	.1830	68.5
10	394	18	5.65	.1455	54.4
11	542	13	.65	.0230	8.6

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: ... *11.D*Date: ... *2/31/10*Effective Head (ft.): ... *30*Area of Orifice (sq. in.) ... *.2*Rise in Pit (ft.): ... *3.43 - 1.60 = 1.83*Initial Weight on Scales (lb.): ... *12.1*Time (sec.): ... *174.3*Discharge (cu. ft. per sec.): ... *.0525*Jet H. P.: ... *.179*

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	62	21.5	9.4	.0382	21.3
2	164	20.	7.9	.0846	47.3
3	246	19.	6.9	.1111	62.1
4	278	18.5	6.4	.1163	65.0
5	298	18.25	6.15	.1200	67.0
6	312	18	5.9	.1202	67.2
7	318	17.75	5.65	.1173	65.6
8	344	17.5	5.4	.1217	68.0
9	378	17.	4.9	.1210	67.6
10	430	16.	3.9	.1095	61.2
11	488	15.	2.9	.0926	51.8
12	558	13.5	1.4	.0512	28.6
13	588	13.	1.9	.0347	19.4

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....12.D.....

Date:.....3/31/10.....

Effective Head (ft.):...30.....

Area of Orifice (sq. in.)3.....

Rise in Pit (ft.):..3.91-1.50=2.41.....

Initial Weight on Scales (lb.):..12.1.....

Time (sec.):1526.....

Discharge (cu. ft. per sec.):..0.79.....

Jet H. P.:..26.92.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	88	26	13.9	.0800	29.7
2	214	24	11.9	.1669	62.0
3	266	23	10.9	.1899	70.5
4	312	22	9.9	.2020	75.1
5	334	21	8.9	.1943	72.1
6	390	20	7.9	.2017	74.9
7	418	19	6.9	.1890	70.2
8	460	18	5.9	.1777	66.0
9	492	17	4.9	.1578	58.6
10	512	16	3.9	.1305	48.5
11	552	15	2.9	.1050	39.0
12	600	13.5	1.4	.0550	20.4
13	642	13	.9	.0378	14.0

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *13 D*.....Date: *3/31/10*.....Effective Head (ft.): *30*.....Area of Orifice (sq. in.) *4*.....Rise in Pit (ft.): *3.88 - 0.99 = 2.89*Initial Weight on Scales (lb.): *12.1*.....Time (sec.): *14.18*.....Discharge (cu. ft. per sec.): *10.19*.....Jet H. P.: *34.75*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	96	30	17.9	.1125	32.3
2	193	28	15.9	.2010	57.9
3	282	26	13.9	.2570	74.0
4	316	25	12.9	.2670	76.8
5	348	24	11.9	.2707	77.9
6	376	23	10.9	.2681	77.1
7	410	22	9.9	.2655	76.4
8	464	20	7.9	.2395	68.9
9	520	18	5.9	.2008	57.8
10	558	16	3.9	.1425	41.0
11	640	14	1.9	.0796	22.9
12	650	13	.9	.0383	11.0

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....14D.....Date:....3/31/10.....Effective Head (ft.):....30.....Area of Orifice (sq. in.)5.....Rise in Pit (ft.):.. 4.2-1.7 = 2.5Initial Weight on Scales (lb.):.. 12.1Time (sec.): 9.95Discharge (cu. ft. per sec.):.. 1.255Jet H. P. :.. 42.8

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	94	34	21.9	.1349	31.5
2	152	32	19.9	.1980	46.3
3	276	29	16.9	.3050	71.2
4	328	27	14.9	.3200	74.7
5	354	26	13.9	.3220	75.2
6	378	25	12.9	.3192	74.5
7	422	23	10.9	.3019	70.4
8	498	20	7.9	.2575	60.1
9	570	16	3.9	.1453	33.9
10	648	13	.9	.0382	8.9

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *15 D*.....Date: *3/31/10*.....Effective Head (ft.): *3.0*..... Area of Orifice (sq. in.) *565*.....Rise in Pit (ft.): *3.64 - 0.86 = 2.78* Initial Weight on Scales (lb.): *12.1*.....Time (sec.): *9.65*..... Discharge (cu. ft. per sec.): *1.44*.....Jet H. P.: *4.92*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	128	35	22.9	.1918	39.0
2	222	32	19.9	.2895	58.8
3	284	30	17.9	.3325	67.5
4	314	29	16.9	.3478	70.6
5	340	28	15.9	.3540	71.9
6	386	26	13.9	.3518	71.5
7	432	23	10.9	.3080	62.6
8	478	20	7.9	.2472	50.2
9	520	16	3.9	.1327	26.9
10	575	13	.9	.0338	6.9

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....16.D.....

Date:....4/2/10.....

Effective Head (ft.):....40.....

Area of Orifice (sq. in.)2.....

Rise in Pit (ft.):...3.69-2.15=1.54..

Initial Weight on Scales (lb.):...12.2....

Time (sec.):12.46.....

Discharge (cu. ft. per sec.):...618....

Jet H. P.:...:2.81.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	102	25	12.8	.0854	30.4
2	164	24	11.8	.1268	45.1
3	290	22	9.8	.1859	66.0
4	346	21	8.8	.1992	70.8
5	374	20.5	8.3	.2028	72.2
6	390	20	7.8	.1990	70.7
7	422	19.5	7.3	.2015	71.6
8	442	19.	6.8	.1970	70.0
9	540	17	4.8	.1695	60.3
10	620	15	2.8	.1136	40.4
11	706	13	.8	.0370	13.2

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....17.D.....

Date:.....4/2/10.....

Effective Head (ft.):....4.0.....

Area of Orifice (sq. in.)3.....

Rise in Pit (ft.):...3.80-1.28=2.52

Initial Weight on Scales (lb.):...12.2....

Time (sec.):13.65.....

Discharge (cu. ft. per sec.):...924....

Jet H. P. :....420.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	100	31	18.8	.1230	29.3
2	226	28	15.8	.2335	55.6
3	280	27	14.8	.2715	64.6
4	312	26	13.8	.2815	67.2
5	350	25	12.8	.2930	69.8
6	400	24	11.8	.3090	73.5
7	426	23	10.8	.3018	71.8
8	504	21	8.8	.2900	69.0
9	620	17	4.8	.1947	46.0
10	676	15	2.8	.1240	29.5
11	720	13	.8	.0377	9.0

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*18.D*.....

Date:.....*4/2/10*.....

Effective Head (ft.):.....*40*..... Area of Orifice (sq. in.)*4*.....

Rise in Pit (ft.):...*3.14 - .75 = 2.39* Initial Weight on Scales (lb.):...*122*....

Time (sec.):*976*..... Discharge (cu. ft. per sec.):...*1222*....

Jet H. P.:.....*556*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>160</i>	<i>35</i>	<i>22.8</i>	<i>.2388</i>	<i>43.0</i>
<i>2</i>	<i>308</i>	<i>31</i>	<i>18.8</i>	<i>.3790</i>	<i>68.2</i>
<i>3</i>	<i>366</i>	<i>29</i>	<i>16.8</i>	<i>.4025</i>	<i>72.4</i>
<i>4</i>	<i>400</i>	<i>28</i>	<i>15.8</i>	<i>.4140</i>	<i>74.5</i>
<i>5</i>	<i>424</i>	<i>27</i>	<i>14.8</i>	<i>.4115</i>	<i>74.0</i>
<i>6</i>	<i>446</i>	<i>26</i>	<i>13.8</i>	<i>.4030</i>	<i>72.5</i>
<i>7</i>	<i>512</i>	<i>24</i>	<i>11.8</i>	<i>.3960</i>	<i>71.2</i>
<i>8</i>	<i>580</i>	<i>20</i>	<i>7.8</i>	<i>.2957</i>	<i>53.2</i>
<i>9</i>	<i>680</i>	<i>16</i>	<i>3.8</i>	<i>.1690</i>	<i>30.4</i>
<i>10</i>	<i>760</i>	<i>13</i>	<i>.8</i>	<i>.0398</i>	<i>7.2</i>

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Volume 17	Number 5	May 1, 1918
Volume 17	Number 6	June 1, 1918
Volume 17	Number 7	July 1, 1918
Volume 17	Number 8	August 1, 1918
Volume 17	Number 9	September 1, 1918
Volume 17	Number 10	October 1, 1918
Volume 17	Number 11	November 1, 1918
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TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....19..D

Date:.....4/2/10.....

Effective Head (ft.):.....40.....

Area of Orifice (sq. in.)5.....

Rise in Pit (ft.):..3.70-74=2.96

Initial Weight on Scales (lb.):..12.2...

Time (sec.):.....99.2.....

Discharge (cu. ft. per sec.):...1491...

Jet H. P.:...678.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	106	41	28.8	.2322	34.3
2	170	36	23.8	.2645	39.0
3	296	34	21.8	.4220	62.5
4	340	33	20.8	.4625	68.2
5	360	32	19.8	.4670	68.8
6	430	30	17.8	.5010	73.8
7	464	26	13.8	.4185	61.7
8	492	21	8.8	.2835	41.8
9	530	17	4.8	.1664	24.5
10	580	13	.8	.0304	4.5

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*20.D*.....

Date:.....*4/2/10*.....

Effective Head (ft.):.....*40*.....

Area of Orifice (sq. in.)*.565*.....

Rise in Pit (ft.):.....*3.71 - .81 = 2.90*.....

Initial Weight on Scales (lb.):.....*12.2*.....

Time (sec.):.....*86.3*.....

Discharge (cu. ft. per sec.):.....*.1680*.....

Jet H. P.:.....*.764*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>126</i>	<i>43</i>	<i>30.8</i>	<i>.2540</i>	<i>33.2</i>
<i>2</i>	<i>220</i>	<i>39</i>	<i>26.8</i>	<i>.3860</i>	<i>50.5</i>
<i>3</i>	<i>234</i>	<i>38</i>	<i>25.8</i>	<i>.3955</i>	<i>51.7</i>
<i>4</i>	<i>238</i>	<i>37</i>	<i>24.8</i>	<i>.3860</i>	<i>50.5</i>
<i>5</i>	<i>260</i>	<i>35</i>	<i>22.8</i>	<i>.3880</i>	<i>50.8</i>
<i>6</i>	<i>290</i>	<i>33</i>	<i>20.8</i>	<i>.3950</i>	<i>51.6</i>
<i>7</i>	<i>364</i>	<i>30</i>	<i>17.8</i>	<i>.4240</i>	<i>55.5</i>
<i>8</i>	<i>428</i>	<i>26</i>	<i>13.8</i>	<i>.3870</i>	<i>50.6</i>
<i>9</i>	<i>460</i>	<i>20</i>	<i>7.8</i>	<i>.2348</i>	<i>30.7</i>
<i>10</i>	<i>500</i>	<i>13</i>	<i>.8</i>	<i>.0262</i>	<i>3.4</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:.....*210*.....

Date:.....*4/8/10*.....

Effective Head (ft.):.....*50*.....

Area of Orifice (sq. in.)*2*.....

Rise in Pit (ft.):...*4.85-2.35=2.5*...

Initial Weight on Scales (lb.):...*12.2*...

Time (sec.):*17.40*.....

Discharge (cu. ft. per sec.):...*0.672*...

Jet H. P. :.....*3.82*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>104</i>	<i>28</i>	<i>15.8</i>	<i>.1075</i>	<i>28.1</i>
<i>2</i>	<i>201</i>	<i>26</i>	<i>13.8</i>	<i>.1818</i>	<i>47.5</i>
<i>3</i>	<i>265</i>	<i>25</i>	<i>12.8</i>	<i>.2220</i>	<i>58.1</i>
<i>4</i>	<i>364</i>	<i>24</i>	<i>11.8</i>	<i>.2807</i>	<i>73.5</i>
<i>5</i>	<i>415</i>	<i>23</i>	<i>10.8</i>	<i>.2935</i>	<i>76.8</i>
<i>6</i>	<i>439</i>	<i>22</i>	<i>9.8</i>	<i>.2815</i>	<i>73.6</i>
<i>7</i>	<i>486</i>	<i>21</i>	<i>8.8</i>	<i>.2800</i>	<i>73.3</i>
<i>8</i>	<i>563</i>	<i>20</i>	<i>7.8</i>	<i>.2875</i>	<i>75.3</i>
<i>9</i>	<i>670</i>	<i>17</i>	<i>4.8</i>	<i>.2100</i>	<i>55.0</i>
<i>10</i>	<i>820</i>	<i>13</i>	<i>.8</i>	<i>.043</i>	<i>11.2</i>

1900

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*22.D*.....

Date:.....*4/8/10*.....

Effective Head (ft.):.....*5.0*.....

Area of Orifice (sq. in.)*3*.....

Rise in Pit (ft.):..*4.75-2.00=2.75*

Initial Weight on Scales (lb.):...*12.2*...

Time (sec.):*13.40*.....

Discharge (cu. ft. per sec.):...*100.5*...

Jet H. P.:...*5.71*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>153</i>	<i>35</i>	<i>22.8</i>	<i>.2282</i>	<i>40.0</i>
<i>2</i>	<i>316</i>	<i>31</i>	<i>18.8</i>	<i>.3880</i>	<i>67.9</i>
<i>3</i>	<i>396</i>	<i>29</i>	<i>16.8</i>	<i>.4355</i>	<i>76.3</i>
<i>4</i>	<i>413</i>	<i>28</i>	<i>15.8</i>	<i>.4270</i>	<i>74.7</i>
<i>5</i>	<i>466</i>	<i>27</i>	<i>14.8</i>	<i>.4515</i>	<i>79.0</i>
<i>6</i>	<i>494</i>	<i>26</i>	<i>13.8</i>	<i>.4460</i>	<i>78.1</i>
<i>7</i>	<i>494</i>	<i>25</i>	<i>12.8</i>	<i>.4140</i>	<i>72.5</i>
<i>8</i>	<i>612</i>	<i>21</i>	<i>8.8</i>	<i>.3525</i>	<i>61.8</i>
<i>9</i>	<i>709</i>	<i>17</i>	<i>4.8</i>	<i>.2228</i>	<i>39.0</i>
<i>10</i>	<i>853</i>	<i>13</i>	<i>.8</i>	<i>.0447</i>	<i>7.8</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*23D*.....

Date:.....*4/8/10*.....

Effective Head (ft.):.....*50*.....

Area of Orifice (sq. in.)*4*.....

Rise in Pit (ft.):..*4.50 - 0.80 = 3.70*

Initial Weight on Scales (lb.):..*12.2*....

Time (sec.):*13.70*.....

Discharge (cu. ft. per sec.):..*13.40*....

Jet H. P.:.....*761*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>121</i>	<i>43</i>	<i>30.8</i>	<i>.2440</i>	<i>32.1</i>
<i>2</i>	<i>232</i>	<i>39</i>	<i>26.8</i>	<i>.4070</i>	<i>53.5</i>
<i>3</i>	<i>268</i>	<i>38</i>	<i>25.8</i>	<i>.4530</i>	<i>59.5</i>
<i>4</i>	<i>314</i>	<i>37</i>	<i>24.8</i>	<i>.5100</i>	<i>67.0</i>
<i>5</i>	<i>348</i>	<i>36</i>	<i>23.8</i>	<i>.5430</i>	<i>71.4</i>
<i>6</i>	<i>362</i>	<i>35</i>	<i>22.8</i>	<i>.5410</i>	<i>71.0</i>
<i>7</i>	<i>382</i>	<i>34</i>	<i>21.8</i>	<i>.5450</i>	<i>71.6</i>
<i>8</i>	<i>432</i>	<i>32</i>	<i>19.8</i>	<i>.5605</i>	<i>73.6</i>
<i>9</i>	<i>538</i>	<i>28</i>	<i>15.8</i>	<i>.5570</i>	<i>73.1</i>
<i>10</i>	<i>598</i>	<i>22</i>	<i>9.8</i>	<i>.3840</i>	<i>50.5</i>
<i>11</i>	<i>666</i>	<i>17</i>	<i>4.8</i>	<i>.2095</i>	<i>27.5</i>
<i>12</i>	<i>770</i>	<i>13</i>	<i>.8</i>	<i>.0404</i>	<i>5.3</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*24.D*.....

Date:....*4./8./10*.....

Effective Head (ft.):....*50*..... Area of Orifice (sq. in.)*5*.....

Rise in Pit (ft.):..*4.80 - 0.75 = 4.05*..... Initial Weight on Scales (lb.):..*12.2*.....

Time (sec.):*1220*..... Discharge (cu. ft. per sec.):..*1670*.....

Jet H. P.:.....*94.9*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>113</i>	<i>48</i>	<i>35.8</i>	<i>.2650</i>	<i>27.9</i>
<i>2</i>	<i>230</i>	<i>43</i>	<i>30.8</i>	<i>.4640</i>	<i>48.9</i>
<i>3</i>	<i>240</i>	<i>41</i>	<i>28.8</i>	<i>.4525</i>	<i>47.7</i>
<i>4</i>	<i>272</i>	<i>39</i>	<i>26.8</i>	<i>.4770</i>	<i>50.2</i>
<i>5</i>	<i>302</i>	<i>37</i>	<i>24.8</i>	<i>.4900</i>	<i>51.6</i>
<i>6</i>	<i>344</i>	<i>35</i>	<i>22.8</i>	<i>.5140</i>	<i>54.1</i>
<i>7</i>	<i>420</i>	<i>31</i>	<i>18.8</i>	<i>.5160</i>	<i>54.4</i>
<i>8</i>	<i>494</i>	<i>25</i>	<i>12.8</i>	<i>.4140</i>	<i>43.6</i>
<i>9</i>	<i>504</i>	<i>19</i>	<i>6.8</i>	<i>.2245</i>	<i>23.6</i>
<i>10</i>	<i>596</i>	<i>13</i>	<i>.8</i>	<i>.0312</i>	<i>3.3</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:.....*250*.....Date:.....*4./8./10*.....Effective Head (ft.):.....*50*..... Area of Orifice (sq. in.)*505*.....Rise in Pit (ft.):..*4.55 - 0.63 = 3.92* Initial Weight on Scales (lb.):..*12.2*...Time (sec.):*10.53*..... Discharge (cu. ft. per sec.):..*18.85*...Jet H. P.*1.07*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>160</i>	<i>49</i>	<i>36.8</i>	<i>.3855</i>	<i>36.0</i>
<i>2</i>	<i>218</i>	<i>45</i>	<i>32.8</i>	<i>.4680</i>	<i>43.8</i>
<i>3</i>	<i>236</i>	<i>43</i>	<i>30.8</i>	<i>.4760</i>	<i>44.5</i>
<i>4</i>	<i>254</i>	<i>41</i>	<i>28.8</i>	<i>.4790</i>	<i>44.8</i>
<i>5</i>	<i>274</i>	<i>39</i>	<i>26.8</i>	<i>.4815</i>	<i>45.0</i>
<i>6</i>	<i>302</i>	<i>37</i>	<i>24.8</i>	<i>.4905</i>	<i>45.9</i>
<i>7</i>	<i>332</i>	<i>35</i>	<i>22.8</i>	<i>.4950</i>	<i>46.3</i>
<i>8</i>	<i>390</i>	<i>30</i>	<i>17.8</i>	<i>.4345</i>	<i>42.5</i>
<i>9</i>	<i>452</i>	<i>25</i>	<i>12.8</i>	<i>.3790</i>	<i>35.4</i>
<i>10</i>	<i>484</i>	<i>20</i>	<i>7.8</i>	<i>.2475</i>	<i>23.1</i>
<i>11</i>	<i>520</i>	<i>13</i>	<i>.8</i>	<i>.0272</i>	<i>2.5</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*26.D*.....

Date:....*4-12-10*.....

Effective Head (ft.):.....*6.0*..... Area of Orifice (sq. in.)*.2*.....

Rise in Pit (ft.):.. *Discharge*.... Initial Weight on Scales (lb.):...*1.00*....

Time (sec.): .. *read from curve* Discharge (cu. ft. per sec.):...*.072*...

Jet H. P.:...*4.91*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>78</i>	<i>21</i>	<i>20</i>	<i>.1020</i>	<i>20.8</i>
<i>2</i>	<i>234</i>	<i>18</i>	<i>17</i>	<i>.2602</i>	<i>73.0</i>
<i>3</i>	<i>332</i>	<i>16</i>	<i>15</i>	<i>.3260</i>	<i>66.4</i>
<i>4</i>	<i>406</i>	<i>15</i>	<i>14</i>	<i>.3720</i>	<i>75.7</i>
<i>5</i>	<i>452</i>	<i>14</i>	<i>13</i>	<i>.3850</i>	<i>78.4</i>
<i>6</i>	<i>494</i>	<i>13</i>	<i>12</i>	<i>.3880</i>	<i>79.0</i>
<i>7</i>	<i>550</i>	<i>11</i>	<i>10</i>	<i>.3600</i>	<i>73.3</i>
<i>8</i>	<i>664</i>	<i>8</i>	<i>7</i>	<i>.3035</i>	<i>61.8</i>
<i>9</i>	<i>778</i>	<i>5</i>	<i>4</i>	<i>.2037</i>	<i>41.5</i>
<i>10</i>	<i>894</i>	<i>2</i>	<i>1</i>	<i>.0585</i>	<i>11.9</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*27.D*....

Date:.....*4./12./10*.....

Effective Head (ft.):.....*60*.....

Area of Orifice (sq. in.)*3*.....

Rise in Pit (ft.):.. *Discharge* ...

Initial Weight on Scales (lb.):...*1.00*....

Time (sec.): *read from curve*...

Discharge (cu. ft. per sec.):...*1.075*...

Jet H. P.:.....*733*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>114</i>	<i>30</i>	<i>29</i>	<i>.2165</i>	<i>29.6</i>
<i>2</i>	<i>252</i>	<i>26</i>	<i>25</i>	<i>.4120</i>	<i>56.3</i>
<i>3</i>	<i>386</i>	<i>23</i>	<i>22</i>	<i>.5555</i>	<i>75.9</i>
<i>4</i>	<i>426</i>	<i>21</i>	<i>20</i>	<i>.5580</i>	<i>76.1</i>
<i>5</i>	<i>511</i>	<i>19</i>	<i>18</i>	<i>.6025</i>	<i>82.2</i>
<i>6</i>	<i>548</i>	<i>17</i>	<i>16</i>	<i>.5740</i>	<i>78.3</i>
<i>7</i>	<i>678</i>	<i>13</i>	<i>12</i>	<i>.5330</i>	<i>72.7</i>
<i>8</i>	<i>738</i>	<i>9</i>	<i>8</i>	<i>.3870</i>	<i>51.5</i>
<i>9</i>	<i>802</i>	<i>5</i>	<i>4</i>	<i>.2100</i>	<i>28.6</i>
<i>10</i>	<i>898</i>	<i>2</i>	<i>1</i>	<i>.0587</i>	<i>8.0</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*28 D*.....Date:.....*4/12/10*.....Effective Head (ft.):.....*60*.....Area of Orifice (sq. in.)*4*.....Rise in Pit (ft.):..*Discharge*....Initial Weight on Scales (lb.):..*1.00*.....Time (sec.):..*reqd. from curve*..Discharge (cu. ft. per sec.):..*1.44*.....Jet H. P. :...*982*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>80</i>	<i>39</i>	<i>38</i>	<i>.1990</i>	<i>20.2</i>
<i>2</i>	<i>260</i>	<i>33</i>	<i>32</i>	<i>.5450</i>	<i>55.5</i>
<i>3</i>	<i>315</i>	<i>29</i>	<i>28</i>	<i>.5770</i>	<i>58.8</i>
<i>4</i>	<i>326</i>	<i>26</i>	<i>25</i>	<i>.5335</i>	<i>54.3</i>
<i>5</i>	<i>486</i>	<i>24</i>	<i>23</i>	<i>.7300</i>	<i>74.4</i>
<i>6</i>	<i>530</i>	<i>22</i>	<i>21</i>	<i>.7290</i>	<i>74.2</i>
<i>7</i>	<i>540</i>	<i>19</i>	<i>18</i>	<i>.6360</i>	<i>64.8</i>
<i>8</i>	<i>564</i>	<i>13</i>	<i>12</i>	<i>.4440</i>	<i>45.2</i>
<i>9</i>	<i>604</i>	<i>8</i>	<i>7</i>	<i>.2765</i>	<i>28.1</i>
<i>10</i>	<i>670</i>	<i>2</i>	<i>1</i>	<i>.0439</i>	<i>4.5</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*29.D*.....Date:.....*4/18/10*.....Effective Head (ft.):....*6.0*.....Area of Orifice (sq. in.)*.5*.....Rise in Pit (ft.):...*Discharge*....Initial Weight on Scales (lb.):...*1.00*.....Time (sec.): *read from curve*Discharge (cu. ft. per sec.):...*1.8*.....Jet H. P. :...*1.228*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>112</i>	<i>44</i>	<i>43</i>	<i>.3155</i>	<i>25.6</i>
<i>2</i>	<i>235</i>	<i>37</i>	<i>36</i>	<i>.5540</i>	<i>45.1</i>
<i>3</i>	<i>260</i>	<i>32</i>	<i>31</i>	<i>.5280</i>	<i>43.0</i>
<i>4</i>	<i>354</i>	<i>26</i>	<i>25</i>	<i>.5795</i>	<i>47.2</i>
<i>5</i>	<i>360</i>	<i>24</i>	<i>23</i>	<i>.5415</i>	<i>44.2</i>
<i>6</i>	<i>425</i>	<i>20</i>	<i>19</i>	<i>.5285</i>	<i>43.1</i>
<i>7</i>	<i>480</i>	<i>16</i>	<i>15</i>	<i>.4710</i>	<i>38.4</i>
<i>8</i>	<i>484</i>	<i>12</i>	<i>11</i>	<i>.3483</i>	<i>28.2</i>
<i>9</i>	<i>556</i>	<i>7</i>	<i>6</i>	<i>.2180</i>	<i>17.8</i>
<i>10</i>	<i>598</i>	<i>2</i>	<i>1</i>	<i>.0392</i>	<i>3.2</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....30.D.....Date:.....4/12/10.....Effective Head (ft.):.....60.....Area of Orifice (sq. in.)565.....Rise in Pit (ft.):..4.25...80=3.45...Initial Weight on Scales (lb.):..1.00.....Time (sec.):8.47.....Discharge (cu. ft. per sec.):..2.036...Jet H. P.:..1.387.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	82	50	49	.2632	19.0
2	120	46	45	.3538	25.5
3	150	44	43	.4220	30.5
4	166	42	41	.4460	32.2
5	224	39	38	.4570	33.0
6	245	36	35	.5610	40.5
7	294	30	29	.5585	40.3
8	414	22	21	.5690	41.1
9	471	14	13	.4010	29.0
10	508	7	6	.1995	14.4
11	566	2	1	.0371	2.7

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING.

No. of test:....*31.D*.....Date:....*4. / 14. / 10.*.....Effective Head (ft.):....*80*.....Area of Orifice (sq. in.)*2*.....Rise in Pit (ft.):*4.31 - 2.48 = 1.83*..Initial Weight on Scales (lb.):...*1.00*....Time (sec.):*10.48*.....Discharge (cu. ft. per sec.):...*0.874*....Jet H. P.:....*795*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>160</i>	<i>26</i>	<i>25</i>	<i>.2619</i>	<i>32.9</i>
<i>2</i>	<i>284</i>	<i>23</i>	<i>22</i>	<i>.4090</i>	<i>51.4</i>
<i>3</i>	<i>374</i>	<i>21</i>	<i>20</i>	<i>.4900</i>	<i>61.6</i>
<i>4</i>	<i>470</i>	<i>19</i>	<i>18</i>	<i>.5501</i>	<i>69.2</i>
<i>5</i>	<i>550</i>	<i>17</i>	<i>16</i>	<i>.5760</i>	<i>72.5</i>
<i>6</i>	<i>628</i>	<i>15</i>	<i>14</i>	<i>.5760</i>	<i>72.5</i>
<i>7</i>	<i>714</i>	<i>12</i>	<i>11</i>	<i>.5145</i>	<i>64.6</i>
<i>8</i>	<i>814</i>	<i>9</i>	<i>8</i>	<i>.4260</i>	<i>53.6</i>
<i>9</i>	<i>938</i>	<i>5</i>	<i>4</i>	<i>.2455</i>	<i>30.8</i>
<i>10</i>	<i>1008</i>	<i>2</i>	<i>1</i>	<i>.0659</i>	<i>8.3</i>

STATE OF NEW YORK

In SENATE,

January 10, 1891.

REPORT

OF THE

COMMISSIONERS OF THE LAND OFFICE,

IN RESPONSE TO A RESOLUTION PASSED BY THE SENATE,

APRIL 18, 1889,

RELATIVE TO THE LANDS BELONGING TO THE STATE.

ALBANY:

NAME OF THE LAND.	ACRES.	AMOUNT PAID FOR THE SAME.	RENTS RECEIVED FROM THE SAME.	RENTS RECEIVED FROM THE SAME.	RENTS RECEIVED FROM THE SAME.
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1. The State of New York.	1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
2. The State of New York.	1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
3. The State of New York.	1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
4. The State of New York.	1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
5. The State of New York.	1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
6. The State of New York.	1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
7. The State of New York.	1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
8. The State of New York.	1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
9. The State of New York.	1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
10. The State of New York.	1,000,000	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:.....*22.D*.....

Date:.....*4/14/10*.....

Effective Head (ft.):.....*8.0*.....

Area of Orifice (sq. in.)*3*.....

Rise in Pit (ft.):.....*3.70 - .81 = 2.89*.....

Initial Weight on Scales (lb.):.....*1.00*.....

Time (sec.):*11.05*.....

Discharge (cu. ft. per sec.):.....*1.309*.....

Jet H. P.:.....*1.19*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>180</i>	<i>38</i>	<i>37</i>	<i>.4360</i>	<i>36.7</i>
<i>2</i>	<i>266</i>	<i>35</i>	<i>34</i>	<i>.5920</i>	<i>49.8</i>
<i>3</i>	<i>354</i>	<i>32</i>	<i>31</i>	<i>.7190</i>	<i>60.4</i>
<i>4</i>	<i>450</i>	<i>29</i>	<i>28</i>	<i>.8245</i>	<i>69.2</i>
<i>5</i>	<i>500</i>	<i>27</i>	<i>26</i>	<i>.8500</i>	<i>71.5</i>
<i>6</i>	<i>550</i>	<i>25</i>	<i>24</i>	<i>.8640</i>	<i>72.6</i>
<i>7</i>	<i>694</i>	<i>19</i>	<i>18</i>	<i>.8180</i>	<i>68.8</i>
<i>8</i>	<i>712</i>	<i>12</i>	<i>11</i>	<i>.5130</i>	<i>43.1</i>
<i>9</i>	<i>860</i>	<i>6</i>	<i>5</i>	<i>.2815</i>	<i>23.6</i>
<i>10</i>	<i>906</i>	<i>2</i>	<i>1</i>	<i>.0594</i>	<i>5.0</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:.....*33.D*.....

Date:.....*4./14./10*.....

Effective Head (ft.):.....*8.0*.....

Area of Orifice (sq. in.)*4*.....

Rise in Pit (ft.):...*Discharge*.....

Initial Weight on Scales (lb.):...*1.00*.....

Time (sec.): *read from curve*..

Discharge (cu. ft. per sec.):...*17.0*.....

Jet H. P.:...*1.248*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>152</i>	<i>47</i>	<i>46</i>	<i>.4570</i>	<i>29.6</i>
<i>2</i>	<i>256</i>	<i>42</i>	<i>41</i>	<i>.6870</i>	<i>44.5</i>
<i>3</i>	<i>280</i>	<i>38</i>	<i>37</i>	<i>.6770</i>	<i>43.8</i>
<i>4</i>	<i>318</i>	<i>34</i>	<i>33</i>	<i>.6870</i>	<i>44.5</i>
<i>5</i>	<i>354</i>	<i>30</i>	<i>29</i>	<i>.6715</i>	<i>43.4</i>
<i>6</i>	<i>426</i>	<i>25</i>	<i>24</i>	<i>.6695</i>	<i>43.2</i>
<i>7</i>	<i>500</i>	<i>20</i>	<i>19</i>	<i>.6215</i>	<i>40.1</i>
<i>8</i>	<i>528</i>	<i>13</i>	<i>12</i>	<i>.4150</i>	<i>26.8</i>
<i>9</i>	<i>590</i>	<i>7</i>	<i>6</i>	<i>.2319</i>	<i>15.0</i>
<i>10</i>	<i>614</i>	<i>2</i>	<i>1</i>	<i>.0402</i>	<i>2.6</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:.....*34 D*.....

Date:.....*4/14/10*.....

Effective Head (ft.):.....*8.0*.....

Area of Orifice (sq. in.)*.5*.....

Rise in Pit (ft.):.....*3.64 - .58 = 3.06*.....

Initial Weight on Scales (lb.):.....*1.00*.....

Time (sec.):*7.25*.....

Discharge (cu. ft. per sec.):.....*.208*.....

Jet H. P.:.....*1.892*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>154</i>	<i>54</i>	<i>53</i>	<i>.5350</i>	<i>28.3</i>
<i>2</i>	<i>196</i>	<i>49</i>	<i>48</i>	<i>.6160</i>	<i>32.6</i>
<i>3</i>	<i>200</i>	<i>45</i>	<i>44</i>	<i>.5760</i>	<i>30.5</i>
<i>4</i>	<i>275</i>	<i>38</i>	<i>37</i>	<i>.6660</i>	<i>35.2</i>
<i>5</i>	<i>320</i>	<i>33</i>	<i>32</i>	<i>.7330</i>	<i>38.8</i>
<i>6</i>	<i>416</i>	<i>27</i>	<i>26</i>	<i>.7085</i>	<i>37.4</i>
<i>7</i>	<i>500</i>	<i>21</i>	<i>20</i>	<i>.6545</i>	<i>34.6</i>
<i>8</i>	<i>568</i>	<i>14</i>	<i>13</i>	<i>.4840</i>	<i>25.6</i>
<i>9</i>	<i>600</i>	<i>7</i>	<i>6</i>	<i>.2355</i>	<i>12.4</i>
<i>10</i>	<i>608</i>	<i>2</i>	<i>1</i>	<i>.0398</i>	<i>2.1</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*35.D*.....Date:.....*4/14/10*.....Effective Head (ft.):.....*8.0*.....Area of Orifice (sq. in.) ...:*5.65*.....Rise in Pit (ft.):.. *Discharge*...Initial Weight on Scales (lb.):.. *1.00*.....Time (sec.): *read from curve*Discharge (cu. ft. per sec.):.. *239.5*...Jet H. P.:...*2.178*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>126</i>	<i>61.8</i>	<i>60.8</i>	<i>.4985</i>	<i>22.9</i>
<i>2</i>	<i>210</i>	<i>50.</i>	<i>49</i>	<i>.6725</i>	<i>30.9</i>
<i>3</i>	<i>250</i>	<i>45</i>	<i>44</i>	<i>.7200</i>	<i>33.1</i>
<i>4</i>	<i>296</i>	<i>40</i>	<i>39</i>	<i>.7555</i>	<i>34.7</i>
<i>5</i>	<i>354</i>	<i>35</i>	<i>34</i>	<i>.7865</i>	<i>36.2</i>
<i>6</i>	<i>412</i>	<i>30</i>	<i>29</i>	<i>.7825</i>	<i>36.0</i>
<i>7</i>	<i>470</i>	<i>24</i>	<i>23</i>	<i>.7060</i>	<i>32.5</i>
<i>8</i>	<i>590</i>	<i>16</i>	<i>15</i>	<i>.5800</i>	<i>26.6</i>
<i>9</i>	<i>624</i>	<i>8</i>	<i>7</i>	<i>.2860</i>	<i>13.1</i>
<i>10</i>	<i>642</i>	<i>2</i>	<i>1</i>	<i>.0420</i>	<i>1.9</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*36 D*...Date:.....*4/26/10*.....Effective Head (ft.):.....*10.0*.....Area of Orifice (sq. in.) *.2*.....Rise in Pit (ft.):..*4.25 - 1.93 = 2.32*.....Initial Weight on Scales (lb.):...*1.2*.....Time (sec.): *116.5*.....Discharge (cu. ft. per sec.):...*.097*.....Jet H. P. :...*1.101*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>145</i>	<i>35</i>	<i>33.8</i>	<i>.3205</i>	<i>29.1</i>
<i>2</i>	<i>222</i>	<i>32</i>	<i>30.8</i>	<i>.4475</i>	<i>40.7</i>
<i>3</i>	<i>342</i>	<i>29</i>	<i>27.8</i>	<i>.6230</i>	<i>56.6</i>
<i>4</i>	<i>464</i>	<i>26</i>	<i>24.8</i>	<i>.7520</i>	<i>68.4</i>
<i>5</i>	<i>536</i>	<i>24</i>	<i>22.8</i>	<i>.8000</i>	<i>72.6</i>
<i>6</i>	<i>632</i>	<i>22</i>	<i>20.8</i>	<i>.8600</i>	<i>78.1</i>
<i>7</i>	<i>700</i>	<i>20</i>	<i>18.8</i>	<i>.8610</i>	<i>78.3</i>
<i>8</i>	<i>820</i>	<i>15</i>	<i>13.8</i>	<i>.7400</i>	<i>67.2</i>
<i>9</i>	<i>1014</i>	<i>9</i>	<i>7.8</i>	<i>.5185</i>	<i>47.1</i>
<i>10</i>	<i>1196</i>	<i>2</i>	<i>.8</i>	<i>.0629</i>	<i>3.7</i>

1. The first group of people who are likely to be affected by the proposed project are the local residents who live in the vicinity of the project site. The project is located in a residential area, and the proposed activities may result in noise, dust, and other disturbances that could affect the quality of life of the local residents. The project proponent should take measures to minimize these impacts, such as implementing noise control measures and dust suppression techniques.

[illegible]

1500

[Faint handwritten notes]

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *37 D*

Date: *4/26/10*

Effective Head (ft.): *1.00*

Area of Orifice (sq. in.) *3*

Rise in Pit (ft.): *4.72 - 1.01 = 3.71*

Initial Weight on Scales (lb.): *1.2*

Time (sec.): *1250*

Discharge (cu. ft. per sec.): *1.450*

Jet H. P.: *1.649*

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	106	50	48.8	.3380	20.5
2	250	45	43.8	.7150	43.4
3	330	42	40.8	.8810	53.5
4	348	40	38.8	.8830	53.6
5	364	38	36.8	.8770	53.3
6	426	34	32.8	.9140	55.5
7	476	30	28.8	.8980	54.5
8	556	24	22.8	.8310	50.5
9	700	15	13.8	.6325	38.4
10	770	2	.8	.0404	2.4

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....38 D....Date:.....4/26/10.....Effective Head (ft.):.....1.00.....Area of Orifice (sq. in.)4.....Rise in Pit (ft.):..4.29-61 = 3.68...Initial Weight on Scales (lb.):...1.2.....Time (sec.):9.45.....Discharge (cu. ft. per sec.):...1.940...Jet H. P.:...2.203.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	136	61.8	60.6	.5400	24.5
2	230	54	52.8	.7945	36.1
3	268	50	48.8	.8550	38.8
4	300	46	44.8	.8780	39.9
5	317	43	41.8	.8660	39.4
6	400	37	35.8	.9370	42.6
7	468	30	28.8	.8830	40.1
8	536	21	19.8	.6250	31.6
9	690	11	9.8	.4425	20.1
10	750	2	.8	.0393	1.8

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....*39...D...*

Date:.....*4/26/10*.....

Effective Head (ft.):....*100*.....

Area of Orifice (sq. in.)*.5*.....

Rise in Pit (ft.):..*4.10 - 1.26 = 2.84*

Initial Weight on Scales (lb.):...*1.2*.....

Time (sec.):*59.8*.....

Discharge (cu. ft. per sec.):...*2.420*..

Jet H. P.*2.75*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>170</i>	<i>64.3</i>	<i>63.1</i>	<i>.702</i>	<i>25.5</i>
<i>2</i>	<i>260</i>	<i>54</i>	<i>52.8</i>	<i>.898</i>	<i>32.7</i>
<i>3</i>	<i>290</i>	<i>50</i>	<i>48.8</i>	<i>.926</i>	<i>33.7</i>
<i>4</i>	<i>324</i>	<i>46</i>	<i>44.8</i>	<i>.950</i>	<i>34.6</i>
<i>5</i>	<i>354</i>	<i>43</i>	<i>41.8</i>	<i>.969</i>	<i>35.2</i>
<i>6</i>	<i>440</i>	<i>37</i>	<i>35.8</i>	<i>1.030</i>	<i>37.5</i>
<i>7</i>	<i>524</i>	<i>30</i>	<i>28.8</i>	<i>.989</i>	<i>36.0</i>
<i>8</i>	<i>682</i>	<i>21</i>	<i>19.8</i>	<i>.885</i>	<i>32.2</i>
<i>9</i>	<i>726</i>	<i>11</i>	<i>9.8</i>	<i>.466</i>	<i>16.8</i>
<i>10</i>	<i>756</i>	<i>4</i>	<i>2.8</i>	<i>.0139</i>	<i>2.8</i>

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *40 D*

Date: *7/26/10*

Effective Head (ft.): *100*

Area of Orifice (sq. in.): *56.5*

Rise in Pit (ft.): *Discharge*

Initial Weight on Scales (lb.): *1.2*

Time (sec.): *read from curve*

Discharge (cu. ft. per sec.): *2.73*

Jet H. P.: *3.1*

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	190	64.3	63.1	.784	25.3
2	270	54	52.8	.934	30.1
3	292	50	48.8	.933	30.1
4	330	46	44.8	.967	31.2
5	380	43	41.8	1.039	33.5
6	458	37	35.8	1.072	34.6
7	530	30	28.8	1.000	32.2
8	678	21	19.8	.879	28.3
9	728	11	9.8	.467	15.1
10	756	4	2.8	.0139	4.5

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *1 P.*.....

Date: *4/22/10*.....

Effective Head (ft.): *20*.....

Area of Orifice (sq. in.) *307*.....

Rise in Pit (ft.): *403 - 2.57 = 1.46*

Initial Weight on Scales (lb.): *1*.....

Time (sec.): *1035*.....

Discharge (cu. ft. per sec.): *0705*.....

Jet H. P.: *1601*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	116	10	9	.0684	42.7
2	148	9	8	.0775	48.4
3	166	8	7	.0761	47.6
4	186	7	6	.0760	47.5
5	214	6	5	.0700	43.7
6	220	5	4	.0575	35.9
7	250	4	3	.0491	30.6
8	266	3	2	.0348	21.8
9	282	2	1	.0185	11.5

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34

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: 2 P.....Date: 4/22/10.....Effective Head (ft.): 20.....Area of Orifice (sq. in.) 442.....Rise in Pit (ft.): 3.36 - 1.62 = 1.74Initial Weight on Scales (lb.): 28.....Time (sec.): 8.46.....Discharge (cu. ft. per sec.): 102.8.....Jet H. P.: 2338.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	76	45	17	.0845	36.2
2	100	44	16	.1048	44.8
3	146	42	14	.1338	57.2
4	182	40	12	.1430	61.2
5	214	38	10	.1400	59.9
6	250	35	7	.1144	49.0
7	290	32	4	.0760	32.5

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *3 P*.....

Date: *4/30/10*.....

Effective Head (ft.): *20*.....

Area of Orifice (sq. in.) *601*.....

Rise in Pit (ft.): *4.8 - 2.5 = 2.3*...

Initial Weight on Scales (lb.): *28*.....

Time (sec.): *810*.....

Discharge (cu. ft. per sec.): *142*.....

Jet H. P.: *349*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>103</i>	<i>50</i>	<i>22</i>	<i>.1488</i>	<i>42.6</i>
<i>2</i>	<i>152</i>	<i>47</i>	<i>19</i>	<i>.1891</i>	<i>54.2</i>
<i>3</i>	<i>184</i>	<i>45</i>	<i>17</i>	<i>.2044</i>	<i>58.6</i>
<i>4</i>	<i>207</i>	<i>43</i>	<i>15</i>	<i>.2035</i>	<i>58.3</i>
<i>5</i>	<i>239</i>	<i>39</i>	<i>11</i>	<i>.1721</i>	<i>49.4</i>
<i>6</i>	<i>270</i>	<i>36</i>	<i>8</i>	<i>.1411</i>	<i>40.5</i>
<i>7</i>	<i>324</i>	<i>32</i>	<i>4</i>	<i>.0848</i>	<i>24.3</i>

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148 2149 2150 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165 2166 2167 2168 2169 2170 2171 2172 2173 2174 2175 2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195 2196 2197 2198 2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210 2211 2212 2213 2214 2215 2216 2217 2218 2219 2220 2221 2222 2223 2224 2225 2226 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 2246 2247 2248 2249 2250 2251 2252 2253 2254 2255 2256 2257 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272 2273 2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298 2299 2300 2301 2302 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317 2318 2319 2320 2321 2322 2323 2324 2325 2326 2327 2328 2329 2330 2331 2332 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347 2348 2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 2371 2372 2373 2374 2375 2376 2377 2378 2379 2380 2381 2382 2383 2384 2385 2386 2387 2388 2389 2390 2391 2392 2393 2394 2395 2396 2397 2398 2399 2400 2401 2402 2403 2404 2405 2406 2407 2408 2409 2410 2411 2412 2413 2414 2415 2416 2417 2418 2419 2420 2421 2422 2423 2424 2425 2426 2427 2428 2429 2430 2431 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448 2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473 2474 2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491 2492 2493 2494 2495 2496 2497 2498 2499 2500 2501 2502 2503 2504 2505 2506 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521 2522 2523 2524 2525 2526 2527 2528 2529 2530 2531 2532 2533 2534 2535 2536 2537 2538 2539 2540 2541 2542 2543 2544 2545 2546 2547 2548 2549 2550 2551 2552 2553 2554 2555 2556 2557 2558 2559 2560 2561 2562 2563 2564 2565 2566 2567 2568 2569 2570 2571 2572 2573 2574 2575 2576 2577 2578 2579 2580 2581 2582 2583 2584 2585 2586 2587 2588 2589 2590 2591 2592 2593 2594 2595 2596 2597 2598 2599 2600 2601 2602 2603 2604 2605 2606 2607 2608 2609 2610 2611 2612 2613 2614 2615 2616 2617 2618 2619 2620 2621 2622 2623 2624 2625 2626 2627 2628 2629 2630 2631 2632 2633 2634 2635 2636 2637 2638 2639 2640 2641 2642 2643 2644 2645 2646 2647 2648 2649 2650 2651 2652 2653 2654 2655 2656 2657 2658 2659 2660 2661 2662 2663 2664 2665 2666 2667 2668 2669 2670 2671 2672 2673 2674 2675 2676 2677 2678 2679 2680 2681 2682 2683 2684 2685 2686 2687 2688 2689 2690 2691 2692 2693 2694 2695 2696 2697 2698 2699 2700 2701 2702 2703 2704 2705 2706 2707 2708 2709 2710 2711 2712 2713 2714 2715 2716 2717 2718 2719 2720 2721 2722 2723 2724 2725 2726 2727 2728 2729 2730 2731 2732 2733 2734 2735 2736 2737 2738 2739 2740 2741 2742 2743 2744 2745 2746 2747 2748 2749 2750 2751 2752 2753 2754 2755 2756 2757 2758 2759 2760 2761 2762 2763 2764 2765 2766 2767 2768 2769 2770 2771 2772 2773 2774 2775 2776 2777 2778 2779 2780 2781 2782 2783 2784 2785 2786 2787 2788 2789 2790 2791 2792 2793 2794 2795 2796 2797 2798 2799 2800 2801 2802 2803 2804 2805 2806 2807 2808 2809 2810 2811 2812 2813 2814 2815 2816 2817 2818

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *4P*.....Date: *4/29/10*.....Effective Head (ft.): *20*.....Area of Orifice (sq. in.) *7.85*.....Rise in Pit (ft.): *3.10 - .45 = 2.65*Initial Weight on Scales (lb.): *28*.....Time (sec.): *70.2*.....Discharge (cu. ft. per sec.): *1.889*.....Jet H. P.: *42.95*.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>112</i>	<i>55</i>	<i>27</i>	<i>.1980</i>	<i>46.1</i>
<i>2</i>	<i>150</i>	<i>52</i>	<i>24</i>	<i>.2355</i>	<i>54.9</i>
<i>3</i>	<i>180</i>	<i>49.5</i>	<i>21.5</i>	<i>.2532</i>	<i>59.0</i>
<i>4</i>	<i>202</i>	<i>46</i>	<i>18</i>	<i>.2376</i>	<i>55.4</i>
<i>5</i>	<i>234</i>	<i>43</i>	<i>15</i>	<i>.2300</i>	<i>53.6</i>
<i>6</i>	<i>264</i>	<i>39</i>	<i>11</i>	<i>.1900</i>	<i>44.3</i>
<i>7</i>	<i>306</i>	<i>35</i>	<i>7</i>	<i>.1402</i>	<i>32.7</i>

TABLE OF LOGARITHMS

OF NUMBERS

FROM 1 TO 10000

AND OF TRIGONOMETRICAL FUNCTIONS

By ADAM EDWARDS, F.R.S. &c.
 Author of the *Trigonometrical Tables*, &c.
 Printed by J. BARNARD, at the *Printers Office*, in *St. Dunstons Church-yard*,
 near *St. Dunstons Church*, in the *City of London*.
 MDCCLXXIII.

Number	Logarithm	Number	Logarithm	Number	Logarithm
1	0.00000	100	1.69897	1000	3.00000
2	0.30103	200	2.30103	2000	3.30103
3	0.47712	300	2.47712	3000	3.47712
4	0.60206	400	2.60206	4000	3.60206
5	0.69897	500	2.69897	5000	3.69897
6	0.77815	600	2.77815	6000	3.77815
7	0.84510	700	2.84510	7000	3.84510
8	0.90309	800	2.90309	8000	3.90309
9	0.95424	900	2.95424	9000	3.95424

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: 5 P.....Date: 4/22/10.....Effective Head (ft.): 40.....Area of Orifice (sq. in.) 307.....Rise in Pit (ft.): 3.41 - 1.24 = 2.17Initial Weight on Scales (lb.): 1.....Time (sec.): 1063.....Discharge (cu. ft. per sec.): .102.....Jet H. P. .464.....

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
1	116	25	24	.1822	39.4
2	172	22	21	.2360	50.9
3	226	19	18	.2725	58.8
4	288	16	15	.2825	61.0
5	338	13	12	.2655	57.3
6	364	10	9	.2140	46.2
7	390	7	6	.1530	33.0
8	430	4	3	.0844	18.2
9	456	2	1	.0298	6.4

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1907

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *6P*Date: *4/22/10*Effective Head (ft.): *40*Area of Orifice (sq. in.): *4.42*Rise in Pit (ft.): *Discharge*Initial Weight on Scales (lb.): *28*Time (sec.): *read from curve*Discharge (cu. ft. per sec.): *1.48*Jet H. P.: *6725*

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>164</i>	<i>60</i>	<i>32</i>	<i>.3435</i>	<i>51.1</i>
<i>2</i>	<i>206</i>	<i>57</i>	<i>29</i>	<i>.3915</i>	<i>58.2</i>
<i>3</i>	<i>235</i>	<i>55</i>	<i>27</i>	<i>.4155</i>	<i>61.9</i>
<i>4</i>	<i>288</i>	<i>50</i>	<i>22</i>	<i>.4150</i>	<i>61.7</i>
<i>5</i>	<i>338</i>	<i>45</i>	<i>17</i>	<i>.3765</i>	<i>56.0</i>
<i>6</i>	<i>376</i>	<i>40</i>	<i>12</i>	<i>.2510</i>	<i>37.3</i>
<i>7</i>	<i>430</i>	<i>35</i>	<i>7</i>	<i>.1970</i>	<i>29.3</i>

STATE OF NEW YORK

IN SENATE

JANUARY 1, 1891

REPORT

OF THE
COMMISSIONERS OF THE LAND OFFICE
IN RESPONSE TO A RESOLUTION PASSED BY THE SENATE
JANUARY 1, 1890
RELATIVE TO THE LANDS BELONGING TO THE STATE

Year	Acres	Value	Per Cent	Total	Per Cent
1880	1,000,000	100,000	100	1,000,000	100
1881	1,000,000	100,000	100	1,000,000	100
1882	1,000,000	100,000	100	1,000,000	100
1883	1,000,000	100,000	100	1,000,000	100
1884	1,000,000	100,000	100	1,000,000	100
1885	1,000,000	100,000	100	1,000,000	100
1886	1,000,000	100,000	100	1,000,000	100
1887	1,000,000	100,000	100	1,000,000	100
1888	1,000,000	100,000	100	1,000,000	100
1889	1,000,000	100,000	100	1,000,000	100
1890	1,000,000	100,000	100	1,000,000	100

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *7 P*Date: *4/30/10*Effective Head (ft.): *40*Area of Orifice (sq. in.) *.601*Rise in Pit (ft.): *5.5 - 2.2 = 3.3*Initial Weight on Scales (lb.): *28*Time (sec.): *810*Discharge (cu. ft. per sec.): *.2038*Jet H. P.: *.9255*

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>110</i>	<i>75</i>	<i>47</i>	<i>.338</i>	<i>36.5</i>
<i>2</i>	<i>186</i>	<i>70</i>	<i>42</i>	<i>.511</i>	<i>55.2</i>
<i>3</i>	<i>248</i>	<i>65</i>	<i>37</i>	<i>.601</i>	<i>65.0</i>
<i>4</i>	<i>259</i>	<i>62</i>	<i>34</i>	<i>.576</i>	<i>62.2</i>
<i>5</i>	<i>315</i>	<i>54</i>	<i>26</i>	<i>.536</i>	<i>58.0</i>
<i>6</i>	<i>393</i>	<i>43</i>	<i>15</i>	<i>.386</i>	<i>41.6</i>
<i>7</i>	<i>484</i>	<i>32</i>	<i>4</i>	<i>.127</i>	<i>13.7</i>

RESEARCH REPORT NO. 100

CONTENTS

CHAPTER I

CHAPTER II

1. Introduction
 2. Objectives
 3. Methodology
 4. Results
 5. Discussion
 6. Conclusion
 7. References
 8. Appendixes
 9. Bibliography
 10. Index

Year	Month	Day	Time	Place	Remarks
1960	10	10	10	10	10
1961	11	11	11	11	11
1962	12	12	12	12	12
1963	1	1	1	1	1
1964	2	2	2	2	2
1965	3	3	3	3	3
1966	4	4	4	4	4
1967	5	5	5	5	5

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *8 P*

Date: *4/29/10*

Effective Head (ft.): *40*

Area of Orifice (sq. in.) *7.85*

Rise in Pit (ft.): *4.05 - 47 = 3.58*

Initial Weight on Scales (lb.): *28*

Time (sec.): *670*

Discharge (cu. ft. per sec.): *267*

Jet H. P.: *1,213*

No.	N Speed R. P. M.	Wgt. on Scales lb.	W Net Load lb.	B. H. P.	Efficiency Per Cent.
<i>1</i>	<i>142</i>	<i>90</i>	<i>62</i>	<i>.576</i>	<i>47.5</i>
<i>2</i>	<i>212</i>	<i>80</i>	<i>52</i>	<i>.720</i>	<i>59.4</i>
<i>3</i>	<i>262</i>	<i>75</i>	<i>47</i>	<i>.805</i>	<i>66.4</i>
<i>4</i>	<i>313</i>	<i>65</i>	<i>37</i>	<i>.757</i>	<i>62.5</i>
<i>5</i>	<i>366</i>	<i>55</i>	<i>27</i>	<i>.646</i>	<i>53.4</i>
<i>6</i>	<i>408</i>	<i>45</i>	<i>17</i>	<i>.454</i>	<i>37.4</i>
<i>7</i>	<i>462</i>	<i>35</i>	<i>7</i>	<i>.212</i>	<i>17.5</i>

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840. 84

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *9 P*Date: *4/22/10*Effective Head (ft.): *60*Area of Orifice (sq. in.) *.307*Rise in Pit (ft.): *3.53 - 1.15 = 2.38*Initial Weight on Scales (lb.): *1*Time (sec.): *944*Discharge (cu. ft. per sec.): *.1261*Jet H. P.: *.861*

| No. | N
Speed
R. P. M. | Wgt. on
Scales
lb. | W
Net Load
lb. | B. H. P. | Efficiency
Per Cent. |
|-----|------------------------|--------------------------|----------------------|----------|-------------------------|
| 1 | 168 | 36 | 35 | .3834 | 44.7 |
| 2 | 208 | 31 | 30 | .4080 | 47.4 |
| 3 | 284 | 29 | 28 | .5210 | 60.5 |
| 4 | 322 | 27 | 26 | .5480 | 63.6 |
| 5 | 356 | 24 | 23 | .5510 | 64.1 |
| 6 | 410 | 20 | 19 | .5100 | 59.3 |
| 7 | 460 | 15 | 14 | .4220 | 49.0 |
| 8 | 504 | 10 | 9 | .2970 | 34.5 |
| 9 | 542 | 5 | 4 | .1418 | 16.5 |
| 10 | 580 | 2 | 1 | .0380 | 4.4 |

THE UNIVERSITY OF CHICAGO

1900-1901

DEPARTMENT OF CHEMISTRY

RESEARCH REPORT

BY

DR. J. H. VAN VLECK

AND

DR. R. D. BARTON

CHICAGO, ILL.

1900-1901

RECEIVED

1901

CHICAGO, ILL.

| DATE | NAME | AGE | SEX | RELATION | REMARKS |
|------|-------------|-----|-----|----------|---------|
| 1900 | JOHN A. | 25 | M | SON | 1 |
| 1901 | MARY B. | 20 | F | DAUGHTER | 2 |
| 1902 | WILLIAM C. | 18 | M | BROTHER | 3 |
| 1903 | ANNE D. | 16 | F | SISTER | 4 |
| 1904 | CHARLES E. | 14 | M | BROTHER | 5 |
| 1905 | MARGARET F. | 12 | F | SISTER | 6 |
| 1906 | JOHN G. | 10 | M | BROTHER | 7 |
| 1907 | MARY H. | 8 | F | SISTER | 8 |
| 1908 | WILLIAM I. | 6 | M | BROTHER | 9 |
| 1909 | MARGARET J. | 4 | F | SISTER | 10 |

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....10...P....

Date:....4/22/10.....

Effective Head (ft.):.....60.....

Area of Orifice (sq. in.)442.....

Rise in Pit (ft.):..254-25=299.

Initial Weight on Scales (lb.):...1.....

Time (sec.):814.....

Discharge (cu. ft. per sec.):...1838...

Jet H. P. :...1.252.....

| No. | N
Speed
R. P. M. | Wgt. on
Scales
lb. | W
Net Load
lb. | B. H. P. | Efficiency
Per Cent. |
|-----|------------------------|--------------------------|----------------------|----------|-------------------------|
| 1 | 150 | 49 | 48 | .471 | 37.6 |
| 2 | 234 | 46 | 45 | .689 | 55.0 |
| 3 | 282 | 43 | 42 | .775 | 61.9 |
| 4 | 314 | 40 | 39 | .801 | 64.0 |
| 5 | 352 | 36 | 35 | .806 | 64.5 |
| 6 | 404 | 30 | 29 | .767 | 61.3 |
| 7 | 435 | 25 | 24 | .684 | 54.6 |
| 8 | 500 | 17 | 16 | .524 | 41.8 |
| 9 | 560 | 10 | 9 | .330 | 26.4 |
| 10 | 600 | 2 | 1 | .039 | 3.1 |

PHYSICAL CHEMISTRY

PROBLEMS

DATE: _____

NAME: _____

1. The following data were obtained for the reaction of hydrogen and iodine at 400°C. Calculate the rate of reaction in terms of the disappearance of hydrogen and the appearance of hydrogen iodide.

Time (min) 0 10 20 30 40 50 60 70 80 90 100

[H₂] (mol/l) 0.10 0.08 0.06 0.04 0.02 0.01 0.005 0.0025 0.00125 0.000625 0.0003125

[I₂] (mol/l) 0.10 0.08 0.06 0.04 0.02 0.01 0.005 0.0025 0.00125 0.000625 0.0003125

[HI] (mol/l) 0 0.04 0.08 0.12 0.16 0.20 0.24 0.28 0.32 0.36 0.40

| Time (min) | [H ₂] (mol/l) | [I ₂] (mol/l) | [HI] (mol/l) | Rate of disappearance of H ₂ (mol/l·min) | Rate of appearance of HI (mol/l·min) |
|------------|---------------------------|---------------------------|--------------|---|--------------------------------------|
| 0 | 0.10 | 0.10 | 0 | | |
| 10 | 0.08 | 0.08 | 0.04 | | |
| 20 | 0.06 | 0.06 | 0.08 | | |
| 30 | 0.04 | 0.04 | 0.12 | | |
| 40 | 0.02 | 0.02 | 0.16 | | |
| 50 | 0.01 | 0.01 | 0.20 | | |
| 60 | 0.005 | 0.005 | 0.24 | | |
| 70 | 0.0025 | 0.0025 | 0.28 | | |
| 80 | 0.00125 | 0.00125 | 0.32 | | |
| 90 | 0.000625 | 0.000625 | 0.36 | | |
| 100 | 0.0003125 | 0.0003125 | 0.40 | | |

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:.....*11. P.*.....

Date:.....*4/30/10.*.....

Effective Head (ft.):.....*6.0*.....

Area of Orifice (sq. in.)*6.01*.....

Rise in Pit (ft.):.....*5.0 - .7 = 4.3*.....

Initial Weight on Scales (lb.):...*2.8*.....

Time (sec.):*86.0*.....

Discharge (cu. ft. per sec.):...*.25*.....

Jet H. P.*1.706*.....

| No. | N
Speed
R. P. M. | Wgt. on
Scales
lb. | W
Net Load
lb. | B. H. P. | Efficiency
Per Cent. |
|----------|------------------------|--------------------------|----------------------|--------------|-------------------------|
| <i>1</i> | <i>106</i> | <i>102</i> | <i>74</i> | <i>.514</i> | <i>30.2</i> |
| <i>2</i> | <i>198</i> | <i>95</i> | <i>67</i> | <i>.868</i> | <i>51.0</i> |
| <i>3</i> | <i>290</i> | <i>86</i> | <i>58</i> | <i>1.100</i> | <i>64.5</i> |
| <i>4</i> | <i>327</i> | <i>83</i> | <i>55</i> | <i>1.178</i> | <i>69.0</i> |
| <i>5</i> | <i>351</i> | <i>78</i> | <i>50</i> | <i>1.149</i> | <i>67.3</i> |
| <i>6</i> | <i>395</i> | <i>68</i> | <i>40</i> | <i>1.033</i> | <i>60.6</i> |
| <i>7</i> | <i>485</i> | <i>57</i> | <i>29</i> | <i>.920</i> | <i>54.0</i> |
| <i>8</i> | <i>606</i> | <i>35</i> | <i>7</i> | <i>.278</i> | <i>16.3</i> |

Journal of Interpersonal Violence 26(10) 1978-1994

1900

[illegible]

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *12 P*.....Date: *4/29/10*.....Effective Head (ft.): *60*.....Area of Orifice (sq. in.) *.785*.....Rise in Pit (ft.): *4.28 - .91 = 3.37*.....Initial Weight on Scales (lb.): *2.8*.....Time (sec.): *510*.....Discharge (cu. ft. per sec.): *.3305*.....Jet H. P.: *2.255*.....

| No. | N
Speed
R. P. M. | Wgt. on
Scales
lb. | W
Net Load
lb. | B. H. P. | Efficiency
Per Cent. |
|----------|------------------------|--------------------------|----------------------|--------------|-------------------------|
| <i>1</i> | <i>107</i> | <i>130</i> | <i>102</i> | <i>.715</i> | <i>31.8</i> |
| <i>2</i> | <i>252</i> | <i>110</i> | <i>82</i> | <i>1.350</i> | <i>59.9</i> |
| <i>3</i> | <i>317</i> | <i>100</i> | <i>72</i> | <i>1.492</i> | <i>66.1</i> |
| <i>4</i> | <i>366</i> | <i>90</i> | <i>62</i> | <i>1.488</i> | <i>66.0</i> |
| <i>5</i> | <i>428</i> | <i>75</i> | <i>47</i> | <i>1.317</i> | <i>58.4</i> |
| <i>6</i> | <i>520</i> | <i>50</i> | <i>22</i> | <i>.748</i> | <i>33.2</i> |
| <i>7</i> | <i>626</i> | <i>35</i> | <i>7</i> | <i>.286</i> | <i>12.7</i> |

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: 13 PDate: 4/22/10Effective Head (ft.): 80Area of Orifice (sq. in.) 3.07Rise in Pit (ft.): 4.67 - .77 = 3.9Initial Weight on Scales (lb.): 1Time (sec.): 1330Discharge (cu. ft. per sec.): 1.467Jet H. P.: 1.332

| No. | N
Speed
R. P. M. | Wgt. on
Scales
lb. | W
Net Load
lb. | B. H. P. | Efficiency
Per Cent. |
|-----|------------------------|--------------------------|----------------------|----------|-------------------------|
| 1 | 126 | 50 | 49 | .4040 | 30.3 |
| 2 | 208 | 47 | 46 | .6260 | 47.0 |
| 3 | 260 | 45 | 44 | .7490 | 56.2 |
| 4 | 304 | 42 | 41 | .8154 | 61.1 |
| 5 | 346 | 38 | 37 | .8370 | 62.9 |
| 6 | 430 | 32 | 31 | .8730 | 65.5 |
| 7 | 490 | 25 | 24 | .7690 | 57.7 |
| 8 | 600 | 15 | 14 | .5500 | 41.3 |
| 9 | 670 | 5 | 4 | .1754 | 13.1 |
| 10 | 704 | 2 | 1 | .0460 | 3.5 |

THE UNIVERSITY OF CHICAGO

1. The first is the fact that the

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: 14 PDate: 4/22/10Effective Head (ft.): 80Area of Orifice (sq. in.) 442Rise in Pit (ft.): 3.67 - .52 = 3.15Initial Weight on Scales (lb.): 1Time (sec.): 745Discharge (cu. ft. per sec.): 2.113Jet H. P.: 1.92

| No. | N
Speed
R. P. M. | Wgt. on
Scales
lb. | W
Net Load
lb. | B. H. P. | Efficiency
Per Cent. |
|-----|------------------------|--------------------------|----------------------|----------|-------------------------|
| 1 | 262 | 61.8 | 60.8 | 1.040 | 54.1 |
| 2 | 330 | 57.4 | 56.4 | 1.217 | 63.4 |
| 3 | 350 | 54. | 53 | 1.213 | 63.2 |
| 4 | 372 | 51 | 50 | 1.217 | 63.4 |
| 5 | 396 | 48 | 47 | 1.218 | 63.5 |
| 6 | 440 | 42 | 41 | 1.180 | 61.5 |
| 7 | 500 | 35 | 34 | 1.111 | 58.0 |
| 8 | 560 | 25 | 24 | 1.880 | 45.9 |
| 9 | 622 | 15 | 14 | 1.570 | 29.7 |
| 10 | 754 | 2 | 1 | 1.049 | 2.6 |

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: *15 P*.....Date: *A/30/10*.....Effective Head (ft.): *80*.....Area of Orifice (sq. in.) *601*.....Rise in Pit (ft.): *4.3 - .8 = 3.5*.....Initial Weight on Scales (lb.): *28*.....Time (sec.): *588*.....Discharge (cu. ft. per sec.): *2975*.....Jet H. P.: *2.703*.....

| No. | N
Speed
R. P. M. | Wgt. on
Scales
lb. | W
Net Load
lb. | B. H. P. | Efficiency
Per Cent. |
|----------|------------------------|--------------------------|----------------------|--------------|-------------------------|
| <i>1</i> | <i>119</i> | <i>130</i> | <i>102</i> | <i>.794</i> | <i>29.3</i> |
| <i>2</i> | <i>206</i> | <i>125</i> | <i>97</i> | <i>1.305</i> | <i>48.3</i> |
| <i>3</i> | <i>296</i> | <i>113</i> | <i>85</i> | <i>1.643</i> | <i>60.8</i> |
| <i>4</i> | <i>327</i> | <i>107</i> | <i>79</i> | <i>1.688</i> | <i>62.4</i> |
| <i>5</i> | <i>388</i> | <i>100</i> | <i>72</i> | <i>1.825</i> | <i>67.5</i> |
| <i>6</i> | <i>468</i> | <i>85</i> | <i>57</i> | <i>1.746</i> | <i>64.5</i> |
| <i>7</i> | <i>538</i> | <i>65</i> | <i>37</i> | <i>1.303</i> | <i>48.1</i> |
| <i>8</i> | <i>712</i> | <i>35</i> | <i>7</i> | <i>.326</i> | <i>12.1</i> |

MAINTENANCE RECORD OF THE PROPERTY

RECORD NO.

DATE OF INSPECTION

BY

REMARKS

351

1900

1900

1900

1900

1900

1900

REMARKS

| NO. | NAME | AGE | SEX | REL. | REMARKS |
|-----|-----------|-----|-----|------|---------|
| 1 | John | 25 | M | H | |
| 2 | Mary | 22 | F | W | |
| 3 | Robert | 20 | M | S | |
| 4 | Elizabeth | 18 | F | D | |
| 5 | William | 15 | M | S | |
| 6 | Anna | 12 | F | D | |
| 7 | James | 10 | M | S | |
| 8 | John | 8 | M | S | |
| 9 | Mary | 6 | F | D | |
| 10 | Robert | 4 | M | S | |

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:....16.P.....

Date:....4/29/10.....

Effective Head (ft.):....8.0.....

Area of Orifice (sq. in.) ...7.85.....

Rise in Pit (ft.):..4.40-1.5=3.95

Initial Weight on Scales (lb.):...2.8.....

Time (sec.):515.....

Discharge (cu. ft. per sec.):...3.835.....

Jet H. P.3.485.....

| No. | N
Speed
R. P. M. | Wgt. on
Scales
lb. | W
Net Load
lb. | B. H. P. | Efficiency
Per Cent. |
|-----|------------------------|--------------------------|----------------------|----------|-------------------------|
| 1 | 190 | 155 | 127 | 1.580 | 45.3 |
| 2 | 294 | 135 | 107 | 2.060 | 59.0 |
| 3 | 304 | 130 | 102 | 2.032 | 58.2 |
| 4 | 364 | 115 | 87 | 2.072 | 59.4 |
| 5 | 452 | 95 | 67 | 1.980 | 56.7 |
| 6 | 500 | 75 | 47 | 1.538 | 44.4 |
| 7 | 708 | 35 | 7 | 1.324 | 9.3 |

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: 17 P.....Date: 4/26/10.....Effective Head (ft.): 100.....Area of Orifice (sq. in.) .307.....Rise in Pit (ft.): 5.1 - .8 = 4.3.....Initial Weight on Scales (lb.): 29.....Time (sec.): 1305.....Discharge (cu. ft. per sec.): .1648.....Jet H. P.: 1.871.....

| No. | N
Speed
R. P. M. | Wgt. on
Scales
lb. | W
Net Load
lb. | B. H. P. | Efficiency
Per Cent. |
|-----|------------------------|--------------------------|----------------------|----------|-------------------------|
| 1 | 106 | 95 | 66 | .455 | 24.3 |
| 2 | 292 | 85 | 56 | 1.070 | 57.1 |
| 3 | 404 | 75 | 46 | 1.217 | 65.0 |
| 4 | 435 | 72 | 43 | 1.222 | 65.4 |
| 5 | 472 | 68 | 39 | 1.203 | 64.4 |
| 6 | 538 | 64 | 35 | 1.232 | 65.9 |
| 7 | 553 | 60 | 31 | 1.121 | 60.0 |
| 8 | 616 | 55 | 26 | 1.049 | 56.0 |
| 9 | 668 | 45 | 16 | .699 | 37.4 |
| 10 | 772 | 33 | 4 | .202 | 10.8 |

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1900-1901

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| NAME | AGE | SEX | RELATION | DATE | REMARKS |
|------|-----|-----|----------|------|---------|
| JOHN | 20 | M | SON | 1900 | |
| MARY | 18 | F | DAUGHTER | 1900 | |
| JOHN | 16 | M | SON | 1900 | |
| MARY | 14 | F | DAUGHTER | 1900 | |
| JOHN | 12 | M | SON | 1900 | |
| MARY | 10 | F | DAUGHTER | 1900 | |
| JOHN | 8 | M | SON | 1900 | |
| MARY | 6 | F | DAUGHTER | 1900 | |
| JOHN | 4 | M | SON | 1900 | |
| MARY | 2 | F | DAUGHTER | 1900 | |
| JOHN | 1 | M | SON | 1900 | |
| MARY | 0 | F | DAUGHTER | 1900 | |

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: ... 18 P

Date: ... 4/26/10

Effective Head (ft.): ... 100

Area of Orifice (sq. in.) ... 44.2

Rise in Pit (ft.): ... 4.5 - .6 = 3.9 ...

Initial Weight on Scales (lb.): ... 29

Time (sec.): ... 80.5

Discharge (cu. ft. per sec.): ... 2421 ...

Jet H. P.: ... 2.752

| No. | N
Speed
R. P. M. | Wgt. on
Scales
lb. | W
Net Load
lb. | B. H. P. | Efficiency
Per Cent. |
|-----|------------------------|--------------------------|----------------------|----------|-------------------------|
| 1 | 176 | 120 | 91 | 1.048 | 38.1 |
| 2 | 288 | 110 | 81 | 1.525 | 55.5 |
| 3 | 390 | 100 | 71 | 1.812 | 65.8 |
| 4 | 437 | 90 | 61 | 1.741 | 63.3 |
| 5 | 514 | 82 | 53 | 1.780 | 64.7 |
| 6 | 580 | 75 | 46 | 1.749 | 63.5 |
| 7 | 632 | 65 | 36 | 1.485 | 54.0 |
| 8 | 656 | 55 | 26 | 1.117 | 40.5 |
| 9 | 758 | 45 | 16 | .795 | 28.8 |
| 10 | 818 | 33 | 4 | .214 | 7.8 |

STATE OF NEW YORK

IN SENATE

January 10, 1901

REPORT

OF THE

COMMISSIONERS

OF THE LAND OFFICE

IN RESPONSE TO A RESOLUTION

PASSED BY THE SENATE

APRIL 10, 1899

ALBANY:

1901

WILLIAM W. BROWN, PRINTER.

| Year | Area | Value | Per Cent | Total | Per Cent |
|------|-----------|-------|----------|-------|----------|
| 1890 | 1,000,000 | 100 | 100 | 100 | 100 |
| 1891 | 1,000,000 | 100 | 100 | 100 | 100 |
| 1892 | 1,000,000 | 100 | 100 | 100 | 100 |
| 1893 | 1,000,000 | 100 | 100 | 100 | 100 |
| 1894 | 1,000,000 | 100 | 100 | 100 | 100 |
| 1895 | 1,000,000 | 100 | 100 | 100 | 100 |
| 1896 | 1,000,000 | 100 | 100 | 100 | 100 |
| 1897 | 1,000,000 | 100 | 100 | 100 | 100 |
| 1898 | 1,000,000 | 100 | 100 | 100 | 100 |
| 1899 | 1,000,000 | 100 | 100 | 100 | 100 |
| 1900 | 1,000,000 | 100 | 100 | 100 | 100 |
| 1901 | 1,000,000 | 100 | 100 | 100 | 100 |

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test: 19 P.....Date: 4/26/10.....Effective Head (ft.): 10.0.....Area of Orifice (sq. in.) .601.....Rise in Pit (ft.): 4.3 - .5 = 3.8...Initial Weight on Scales (lb.): 29.....Time (sec.): 578.....Discharge (cu. ft. per sec.): .3282...Jet H. P.: 3.73.....

| No. | N
Speed
R. P. M. | Wgt. on
Scales
lb. | W
Net Load
lb. | B. H. P. | Efficiency
Per Cent. |
|-----|------------------------|--------------------------|----------------------|----------|-------------------------|
| 1 | 238 | 150 | 121 | 1.885 | 50.5 |
| 2 | 298 | 140 | 111 | 2.164 | 58.0 |
| 3 | 380 | 125 | 96 | 2.385 | 64.0 |
| 4 | 412 | 117 | 88 | 2.372 | 63.6 |
| 5 | 502 | 109 | 80 | 2.625 | 70.4 |
| 6 | 540 | 100 | 71 | 2.508 | 67.3 |
| 7 | 609 | 85 | 56 | 2.230 | 59.8 |
| 8 | 670 | 70 | 41 | 1.797 | 48.1 |
| 9 | 746 | 50 | 21 | 1.025 | 27.5 |
| 10 | 810 | 33 | 4 | .212 | 5.7 |

[illegible]

1890

[illegible]

TESTS OF WATER MOTORS

THESIS OF

C. BOYLE, JR.

A. O. SPIERLING

No. of test:.. *20 P*Date:.... *4/26/10*Effective Head (ft.):.... *100*Area of Orifice (sq. in.) ... *7.85*Rise in Pit (ft.):.. *Discharge read*Initial Weight on Scales (lb.):.. *29*Time (sec.): *from curve* ..Discharge (cu. ft. per sec.):... *427*Jet H. P.:... *4.85*

| No. | N
Speed
R. P. M. | Wgt. on
Scales
lb. | W
Net Load
lb. | B. H. P. | Efficiency
Per Cent. |
|-----|------------------------|--------------------------|----------------------|----------|-------------------------|
| 1 | 94 | 210 | 181 | 1.111 | 22.9 |
| 2 | 192 | 190 | 161 | 2.022 | 41.7 |
| 3 | 292 | 170 | 141 | 2.695 | 55.6 |
| 4 | 350 | 150 | 121 | 2.770 | 57.1 |
| 5 | 396 | 135 | 106 | 2.745 | 56.6 |
| 6 | 470 | 120 | 91 | 2.800 | 57.7 |
| 7 | 534 | 100 | 71 | 2.478 | 51.0 |
| 8 | 594 | 80 | 51 | 1.981 | 40.8 |
| 9 | 690 | 60 | 31 | 1.400 | 28.8 |
| 10 | 836 | 33 | 4 | .219 | 4.5 |

Key to the
EFFICIENCY CURVES
DOBLE MOTOR

| No. | Point | Orifice
Area
(sq. in.) |
|-----|-------|------------------------------|
|-----|-------|------------------------------|

| | | |
|---|---|------|
| 1 | ○ | .2 |
| 2 | ▲ | .3 |
| 3 | ⊗ | .4 |
| 4 | ● | .5 |
| 5 | ⊙ | .565 |

11020
11021
11022

DOBLE 12-INCH MOTOR
EFFICIENCY CURVES
Effective Head :- 10 ft.

Efficiency -
Per Cent

80

70

60

50

40

30

20

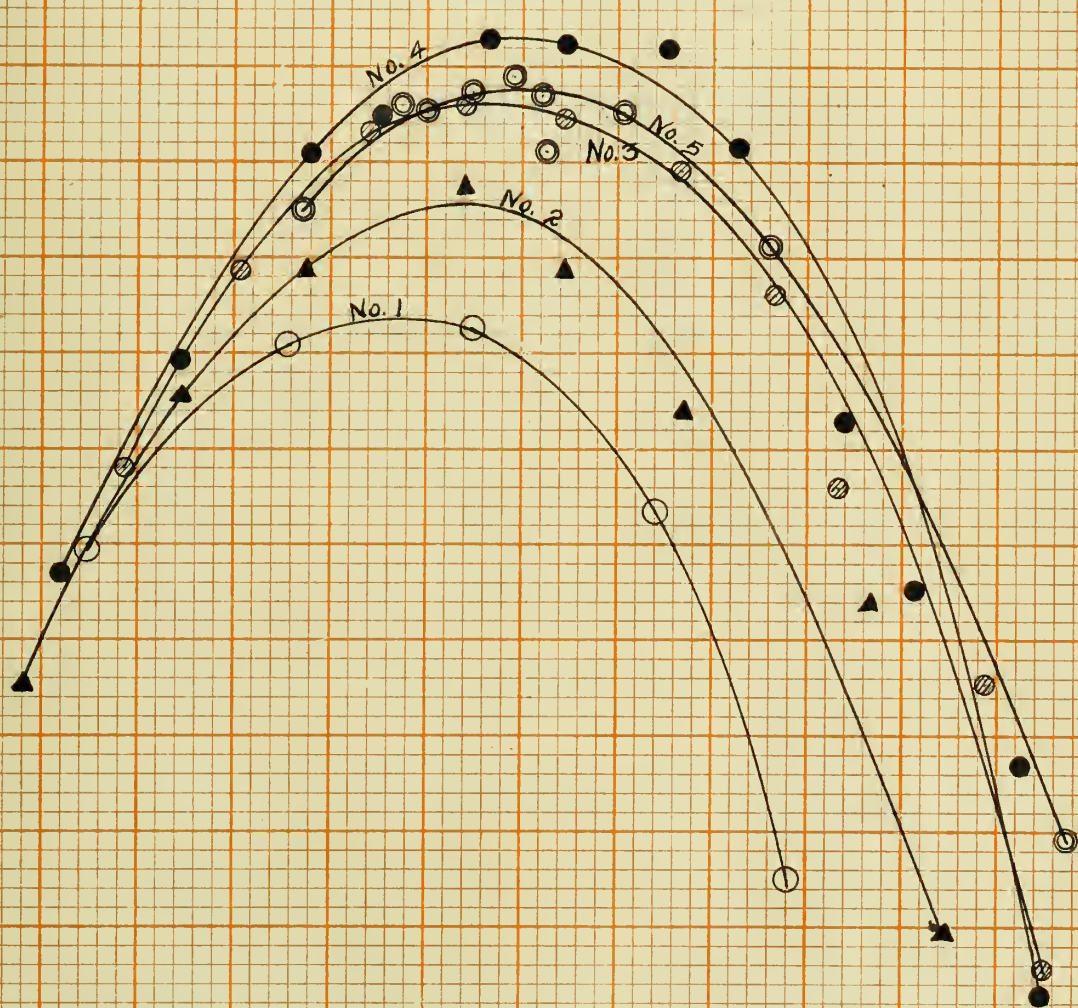
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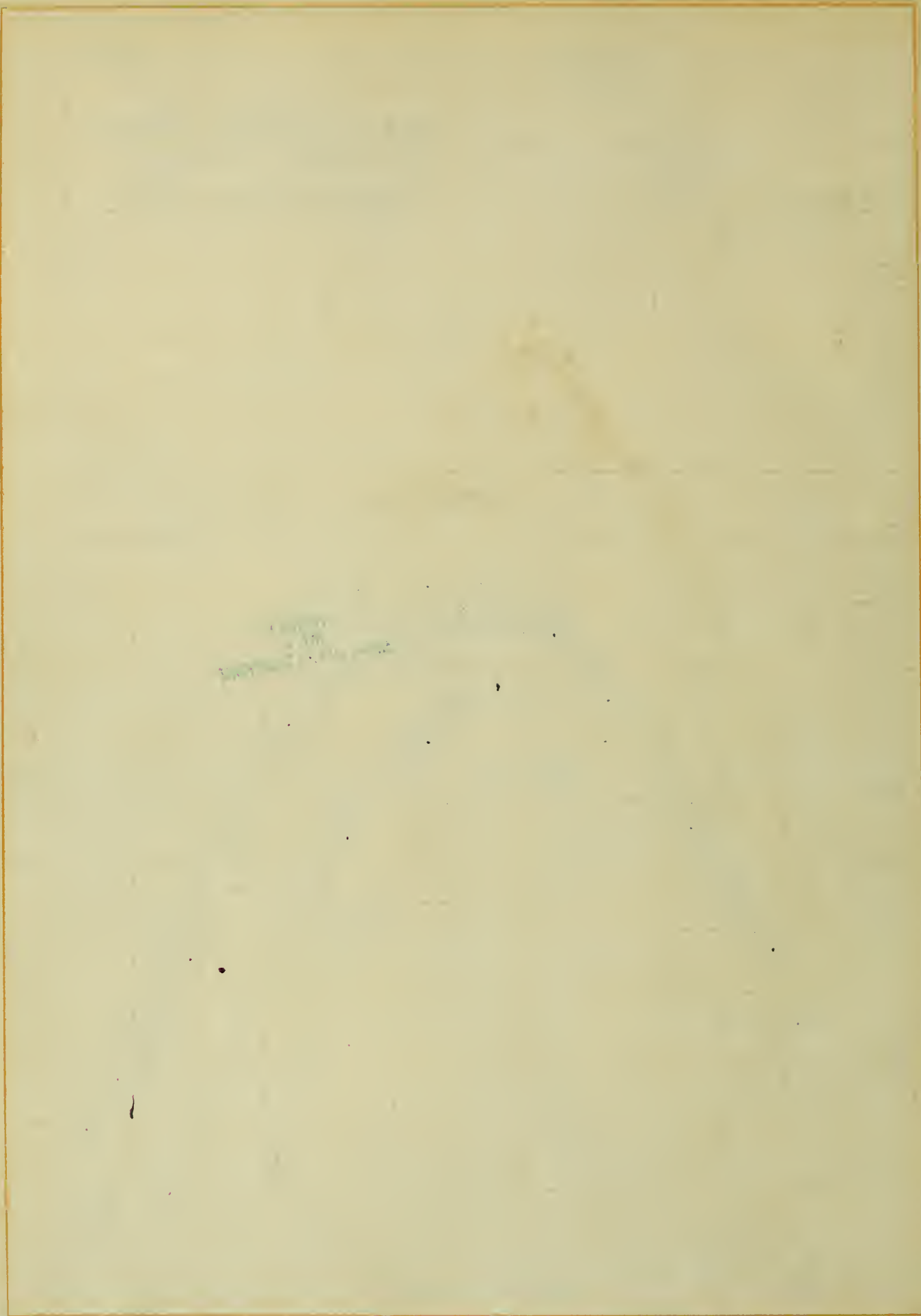
Speed - R.P.M.

100

200

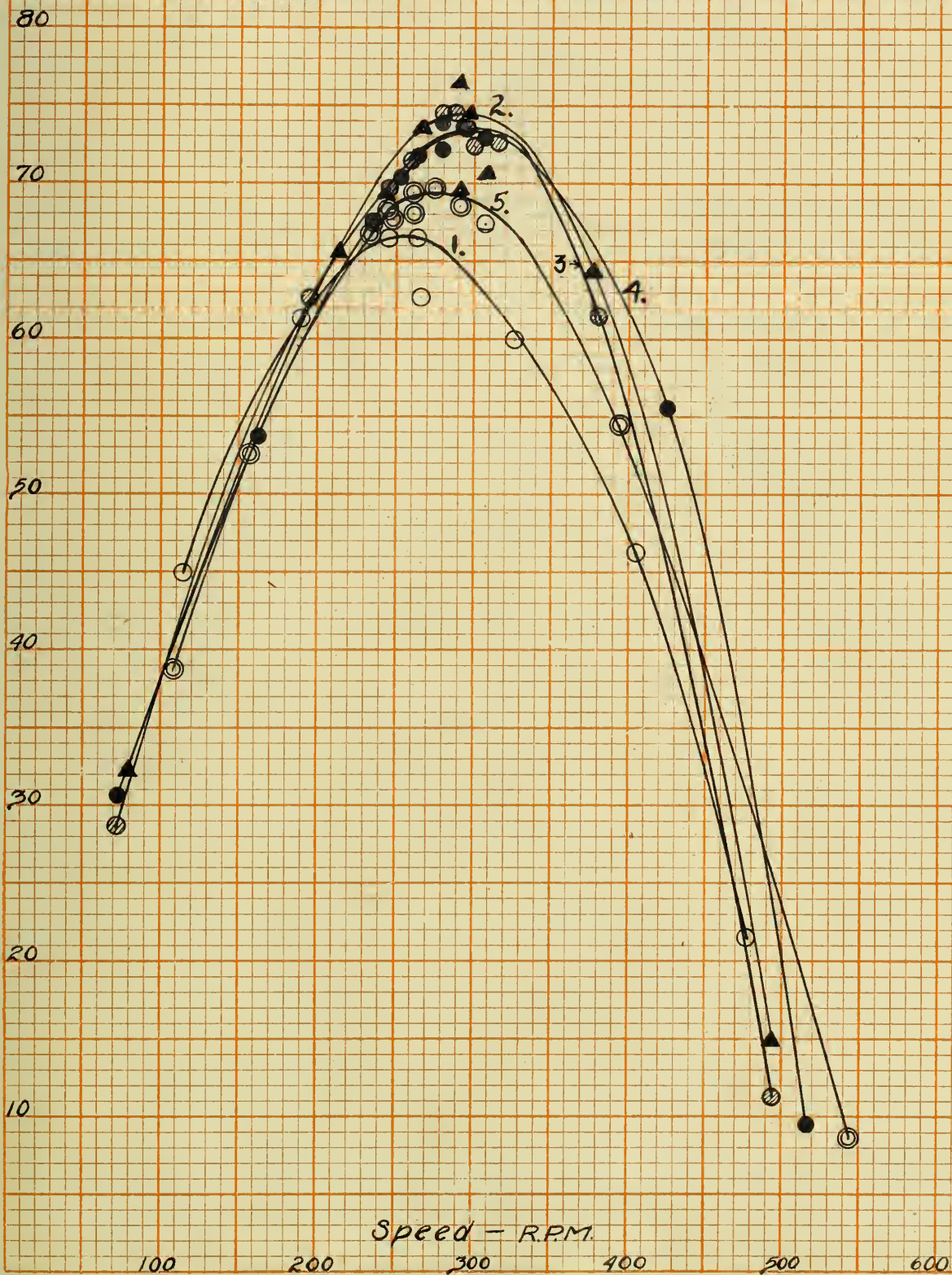
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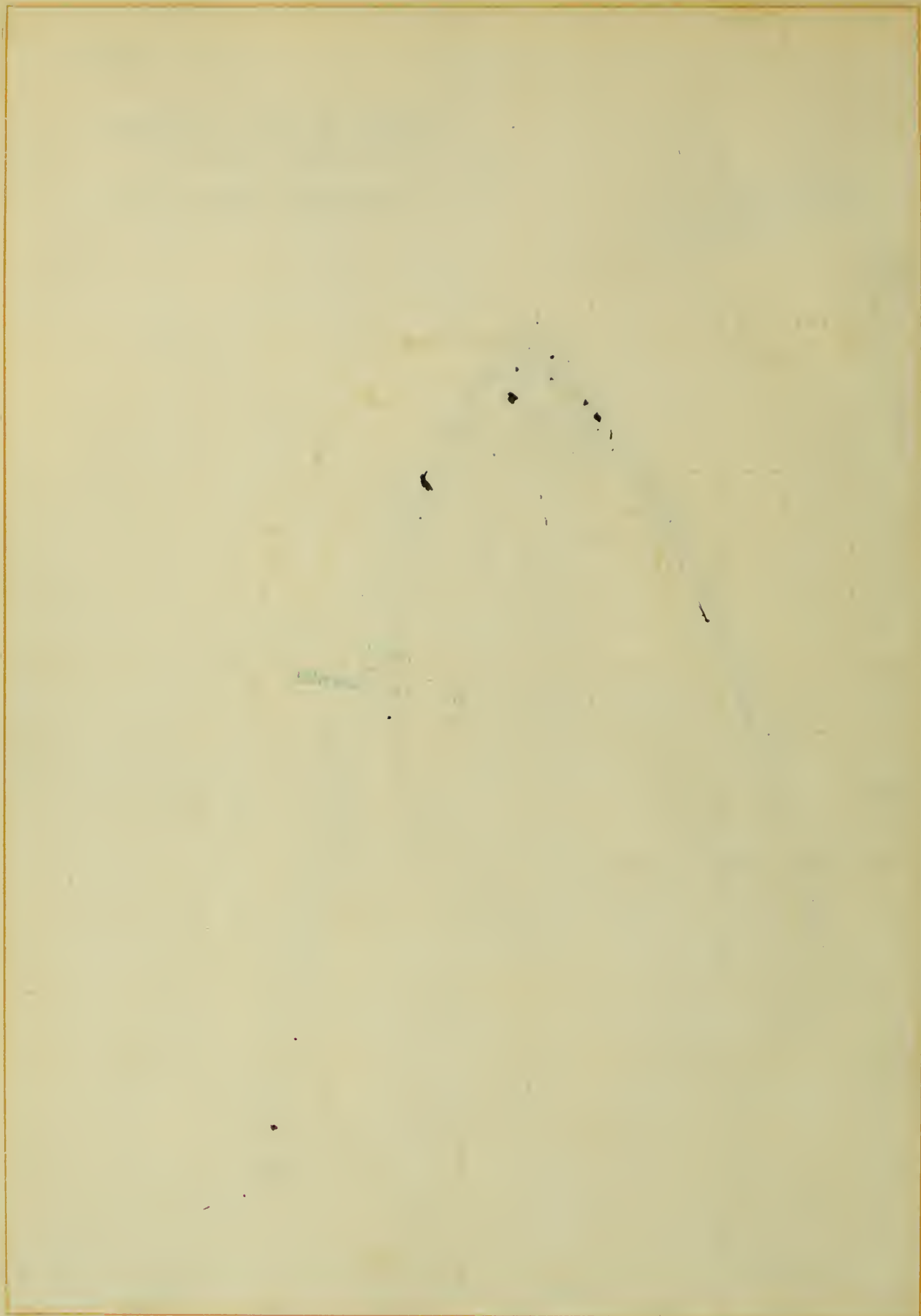




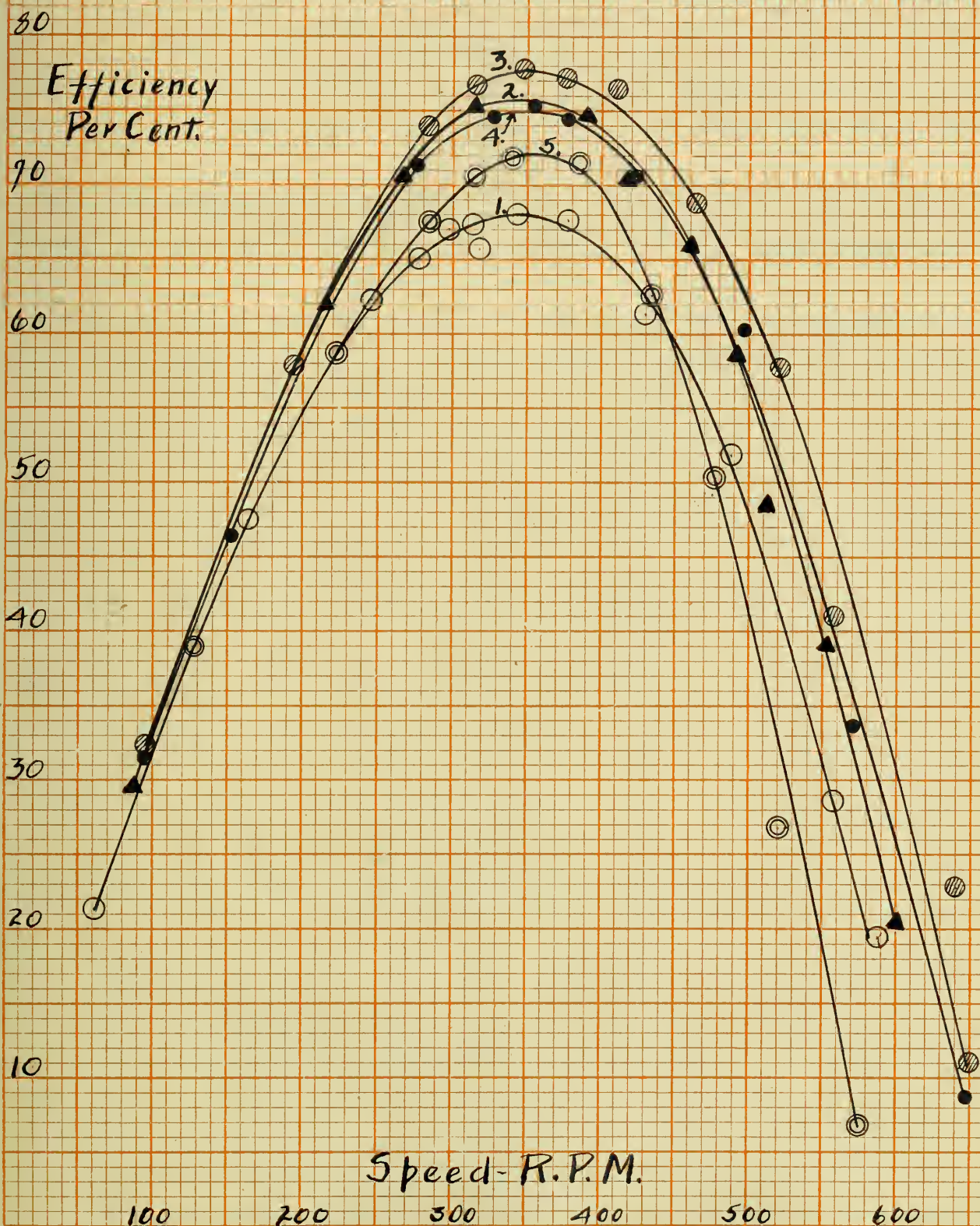
DOBLE 12-INCH MOTOR
EFFICIENCY CURVES
Effective Head: 20 ft.

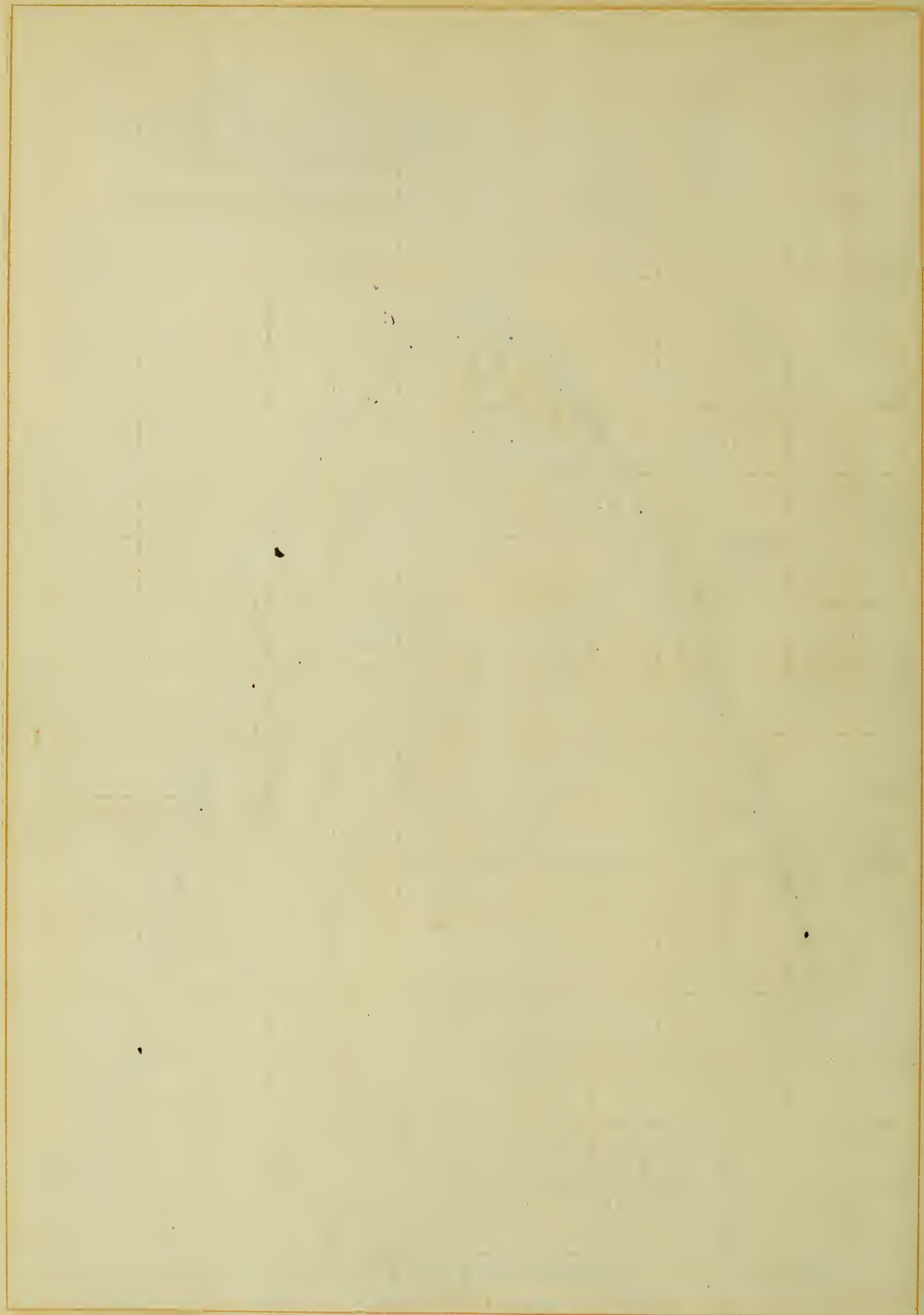
Efficiency -
Per Cent





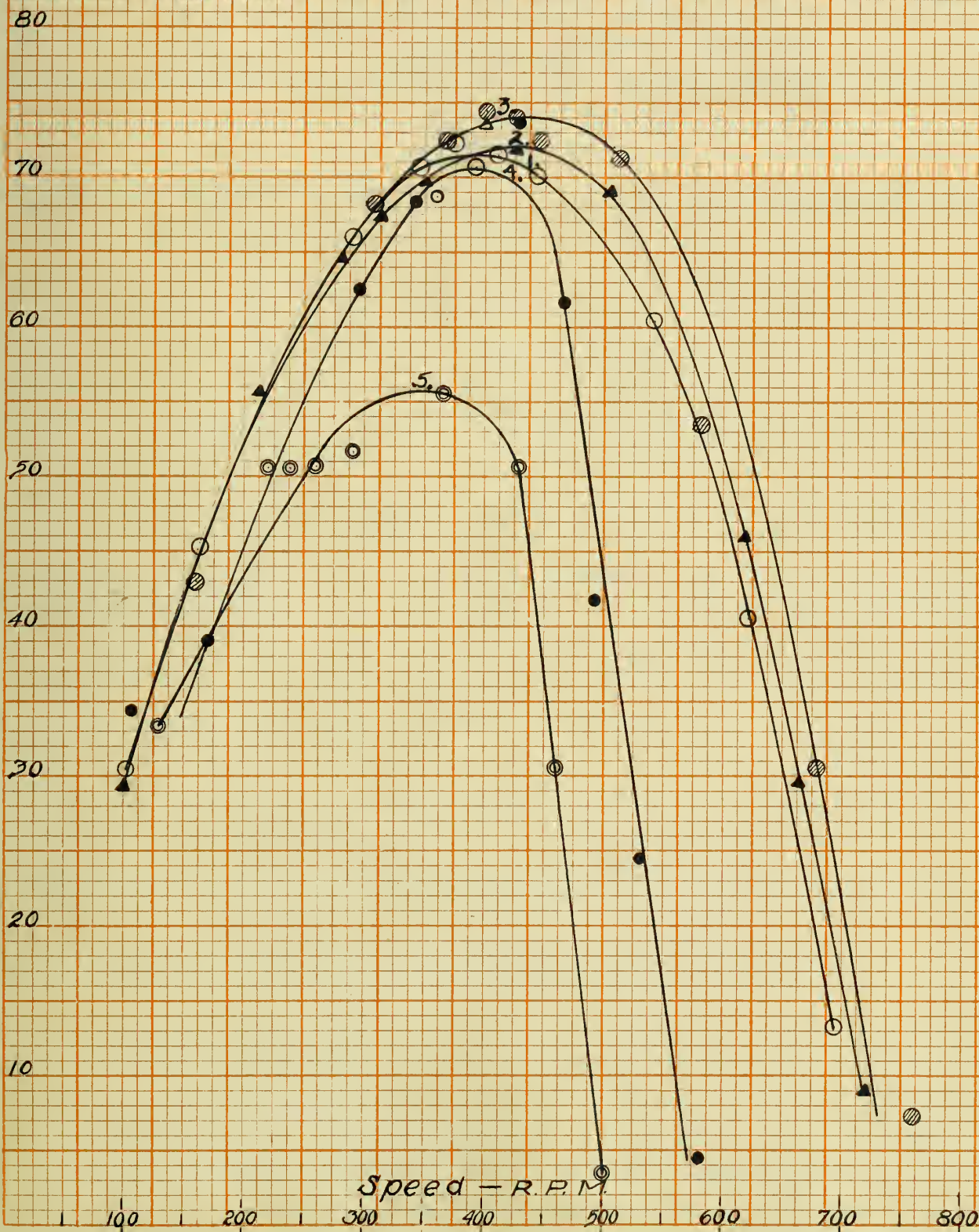
DOUBLE 12-INCH MOTOR
EFFICIENCY CURVES
Effective Head:-30 ft.

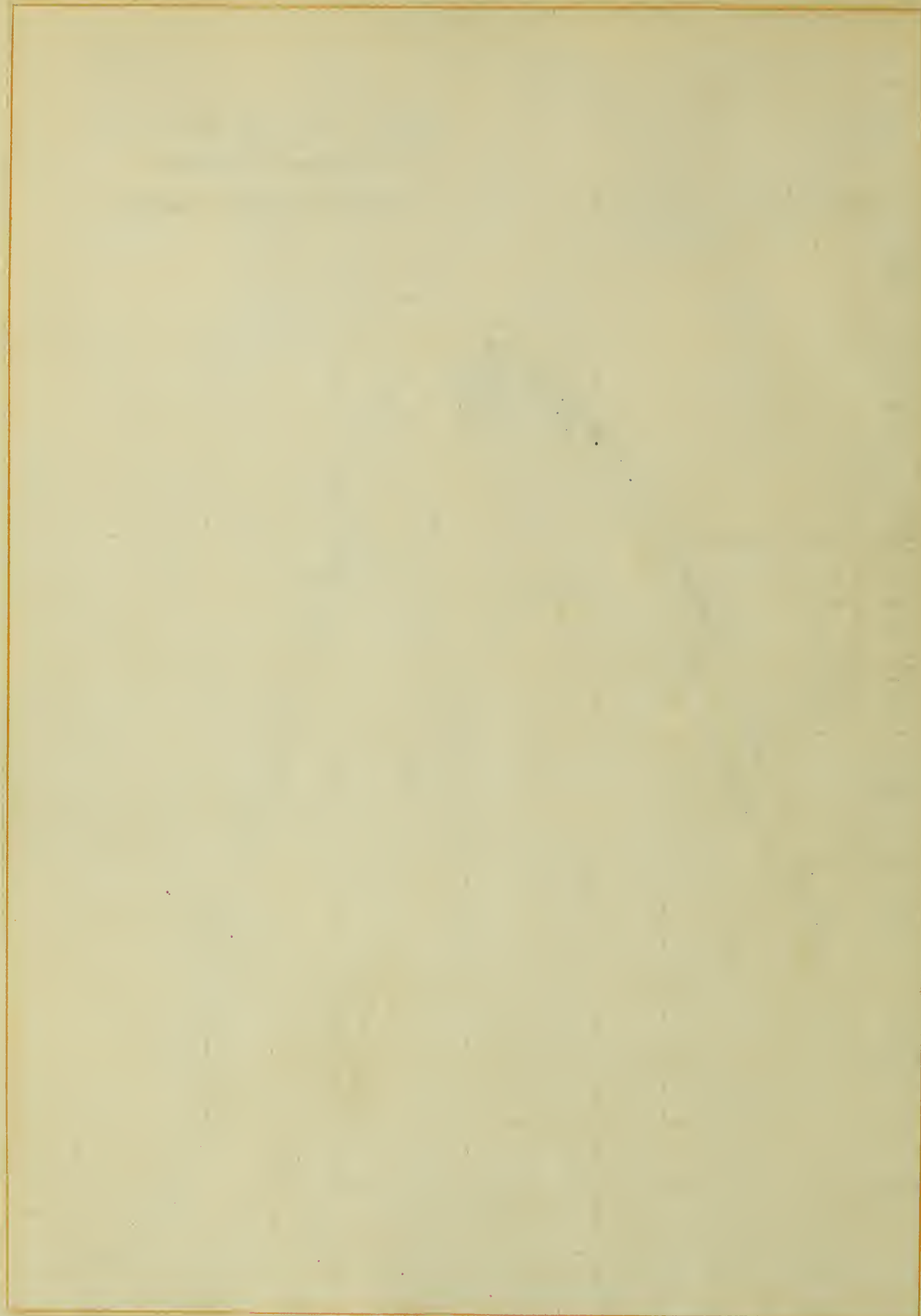




DOBLE 12-INCH MOTOR
EFFICIENCY CURVES

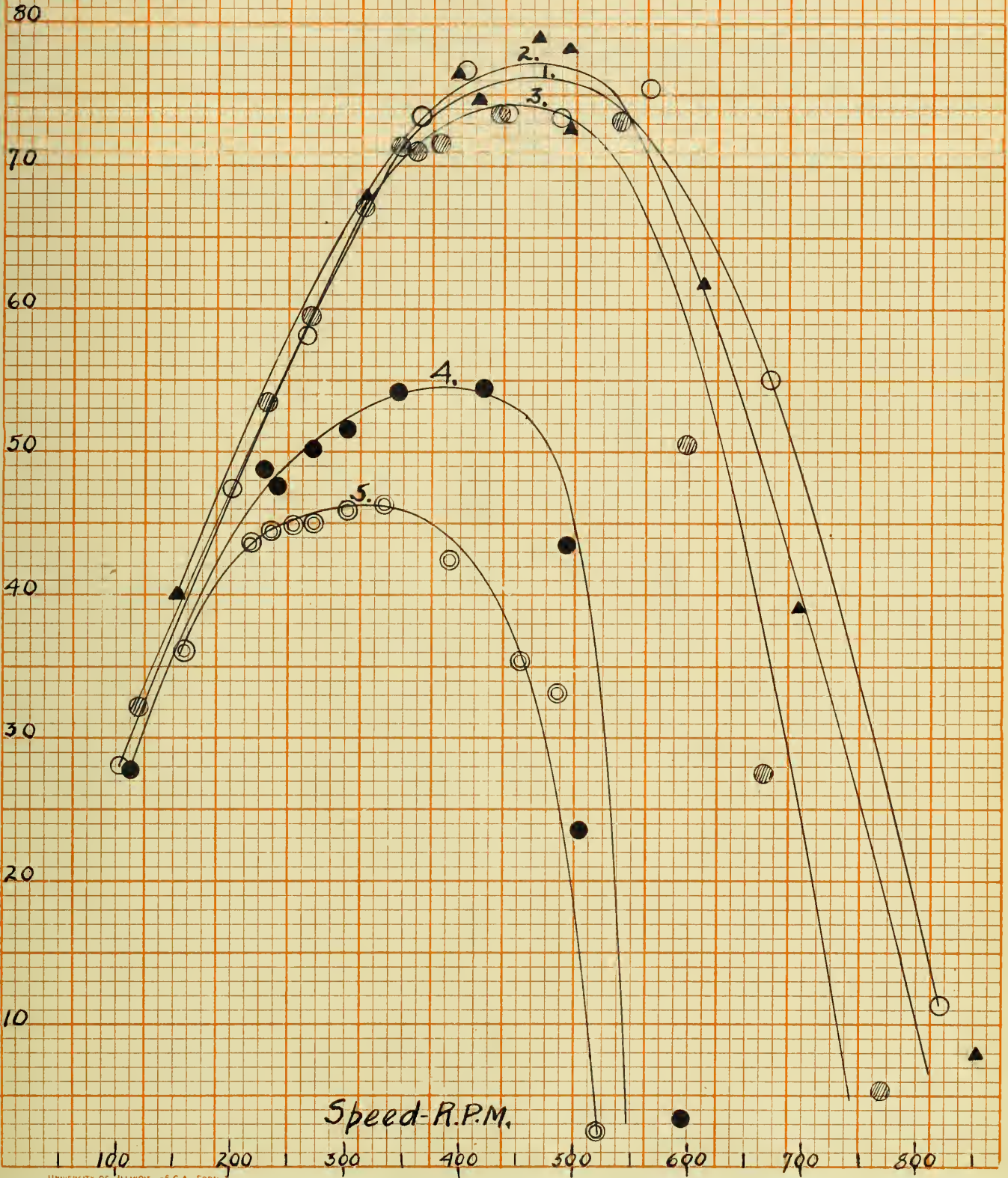
Effective Head:- 40 ft.

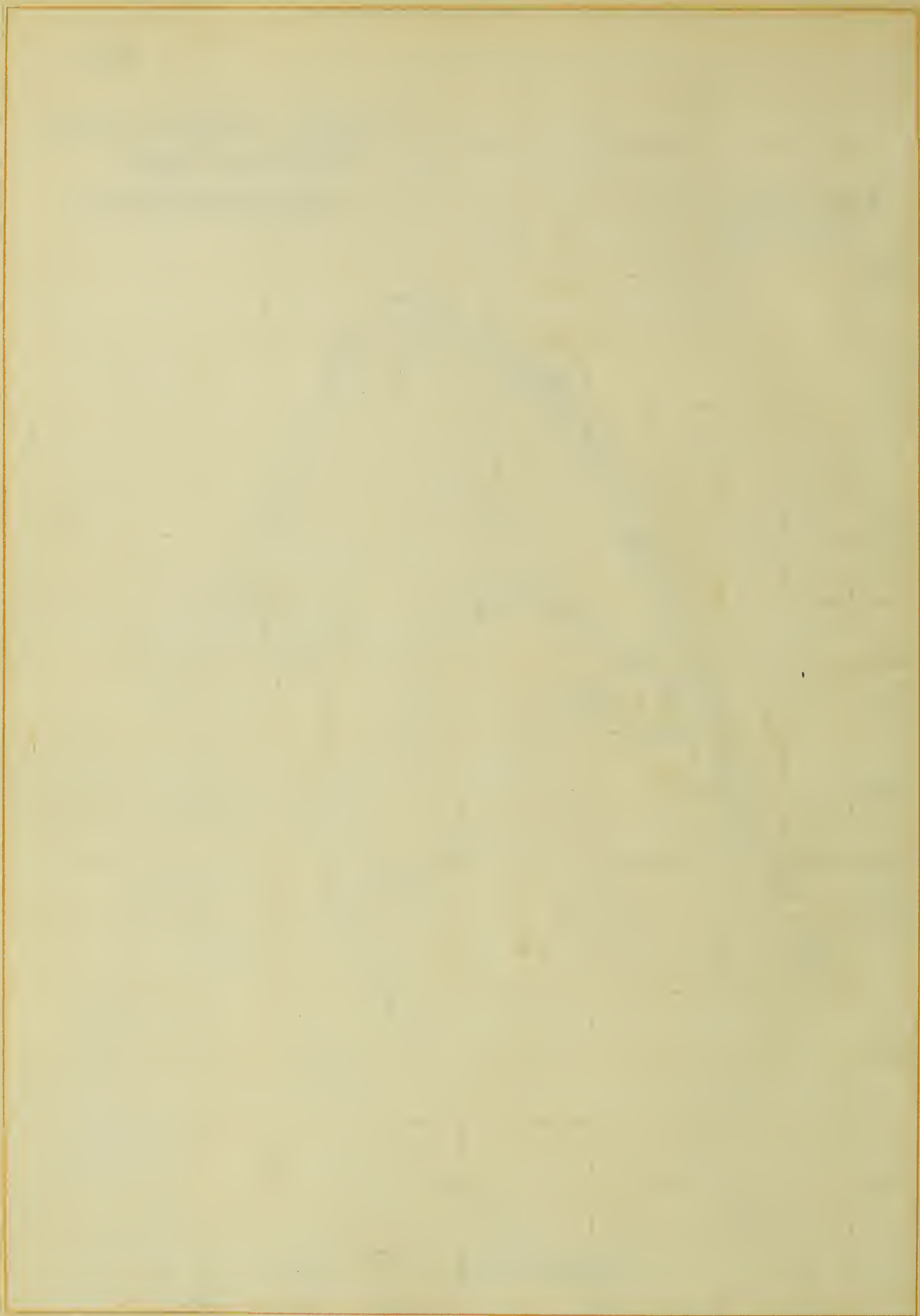
Efficiency —
Per Cent



DOUBLE 12-INCH MOTOR
EFFICIENCY CURVES
Effective Head: 50 ft.

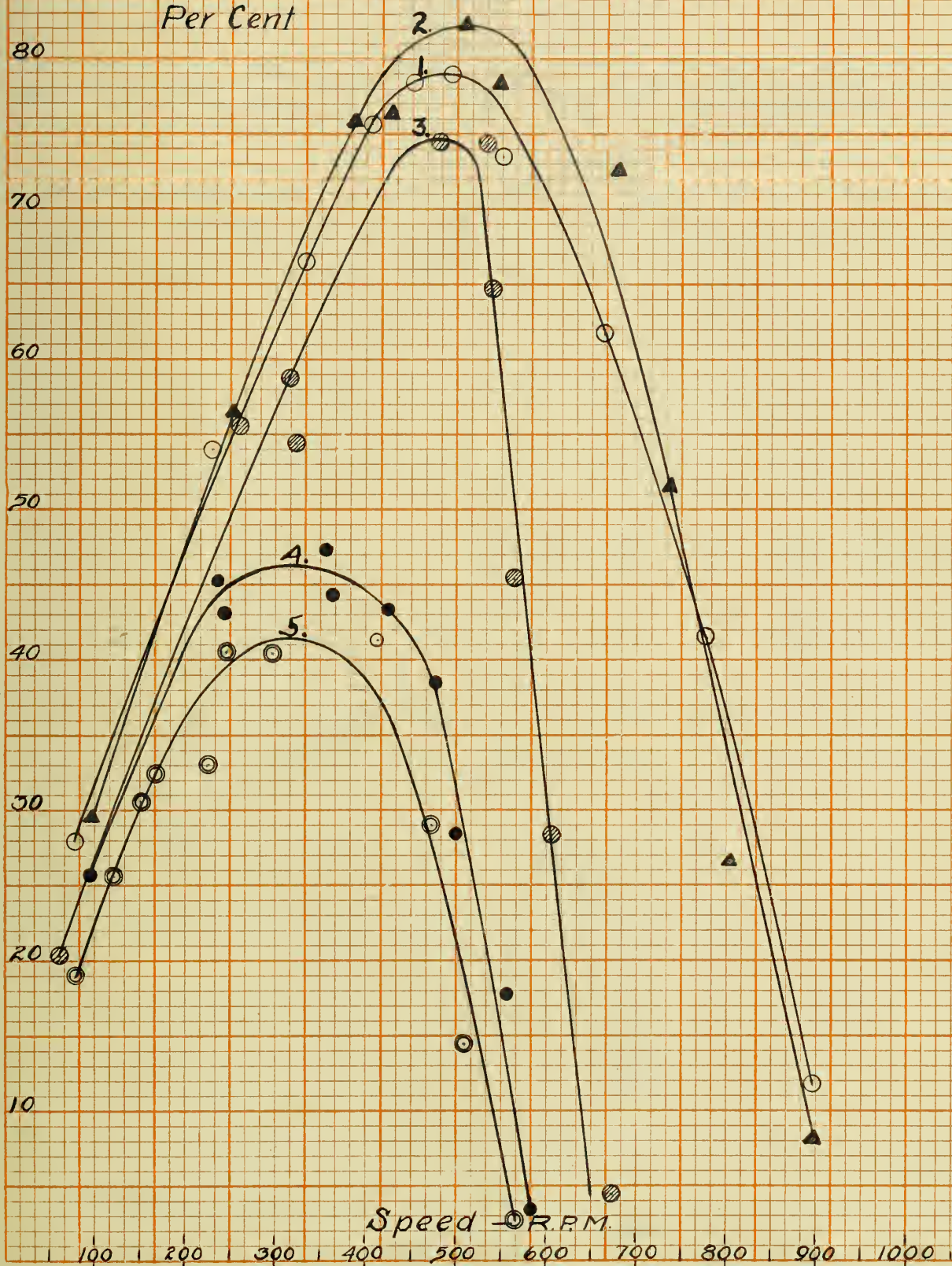
Efficiency-
Per Cent

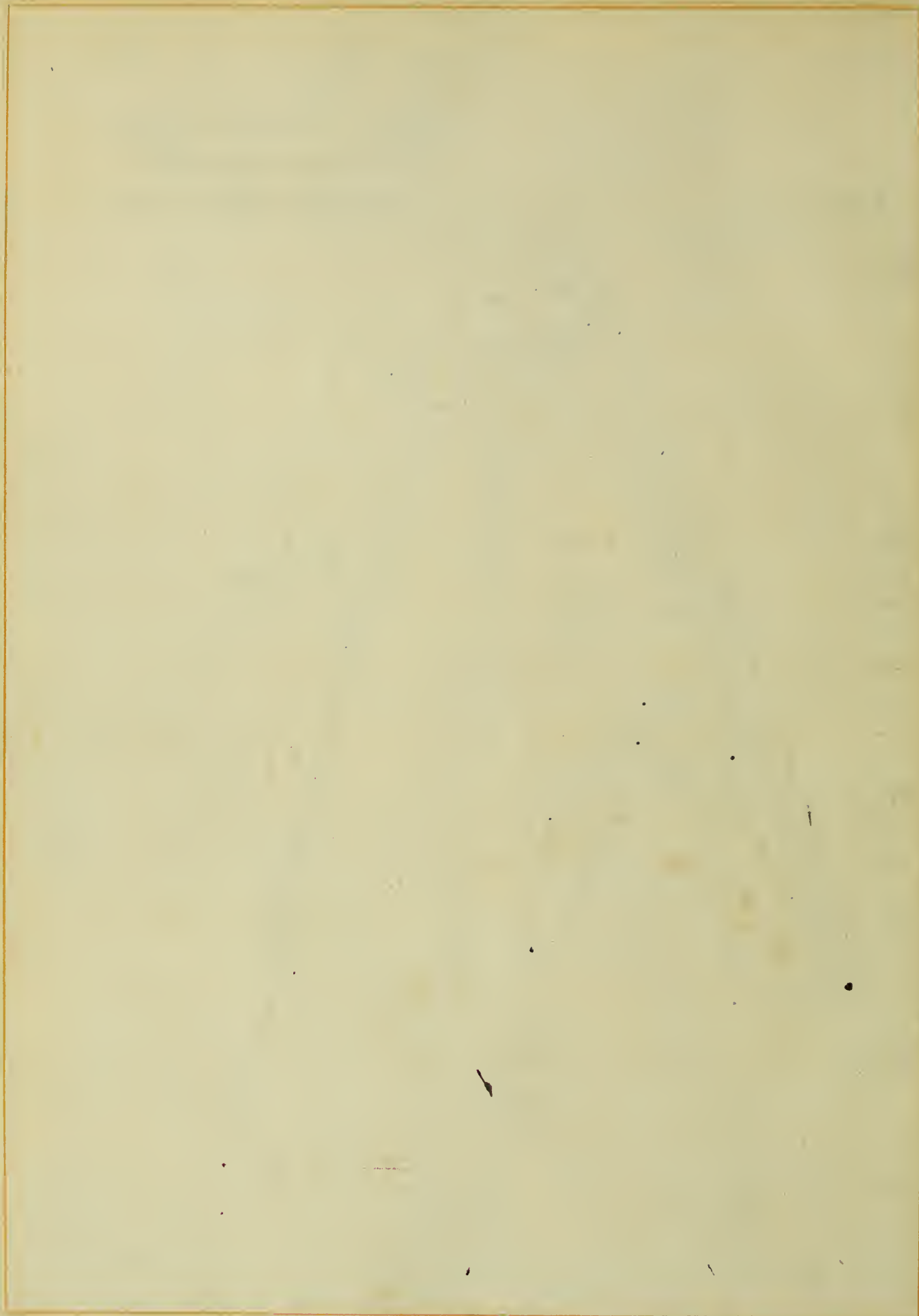




DOUBLE 12-INCH MOTOR
EFFICIENCY CURVES
Effective Head:- 60 ft.

Efficiency -
Per Cent





DOBLE 12-INCH MOTOR
EFFICIENCY CURVES
Effective Head: 80 ft.

Efficiency
Per Cent

80

70

60

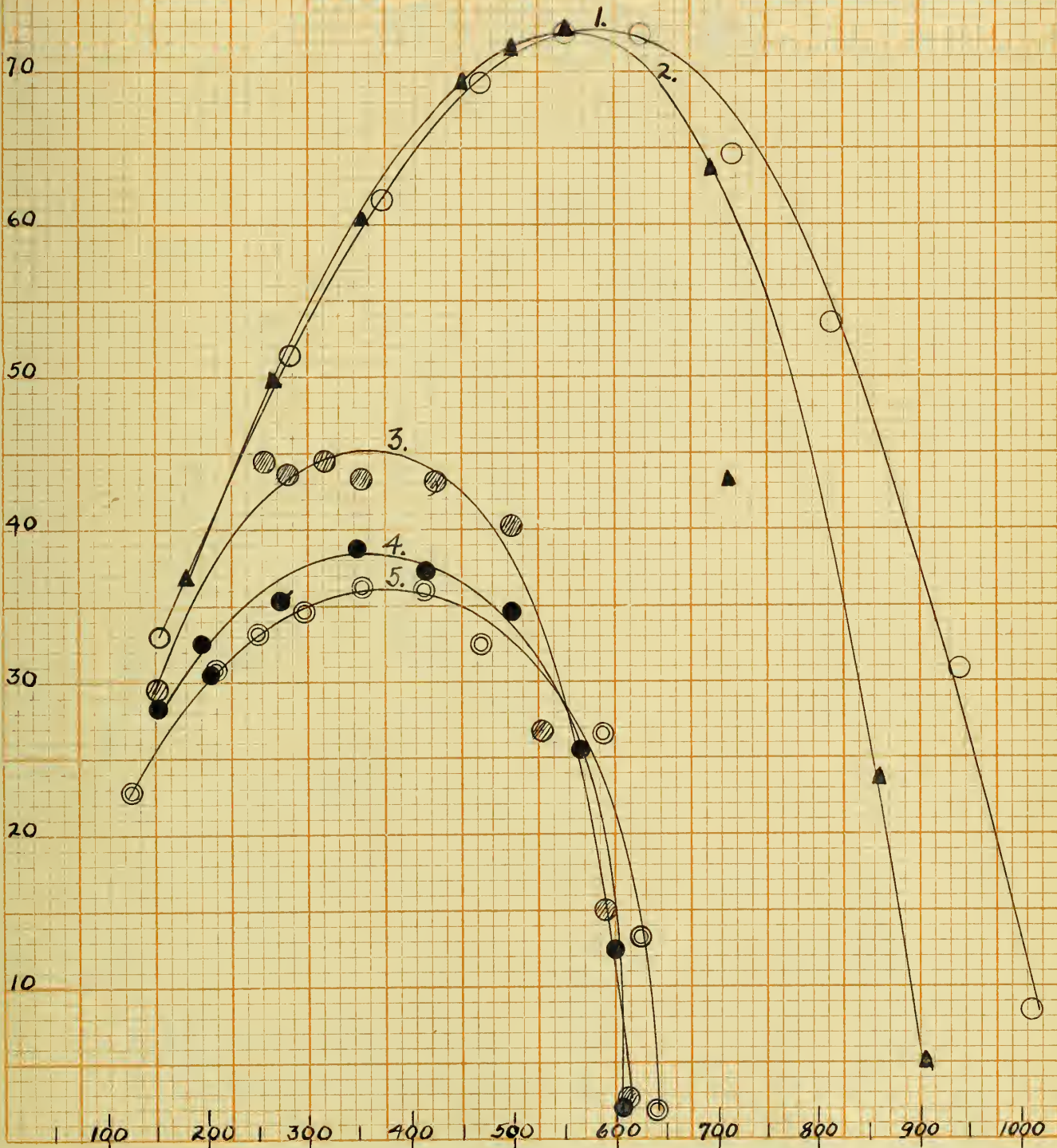
50

40

30

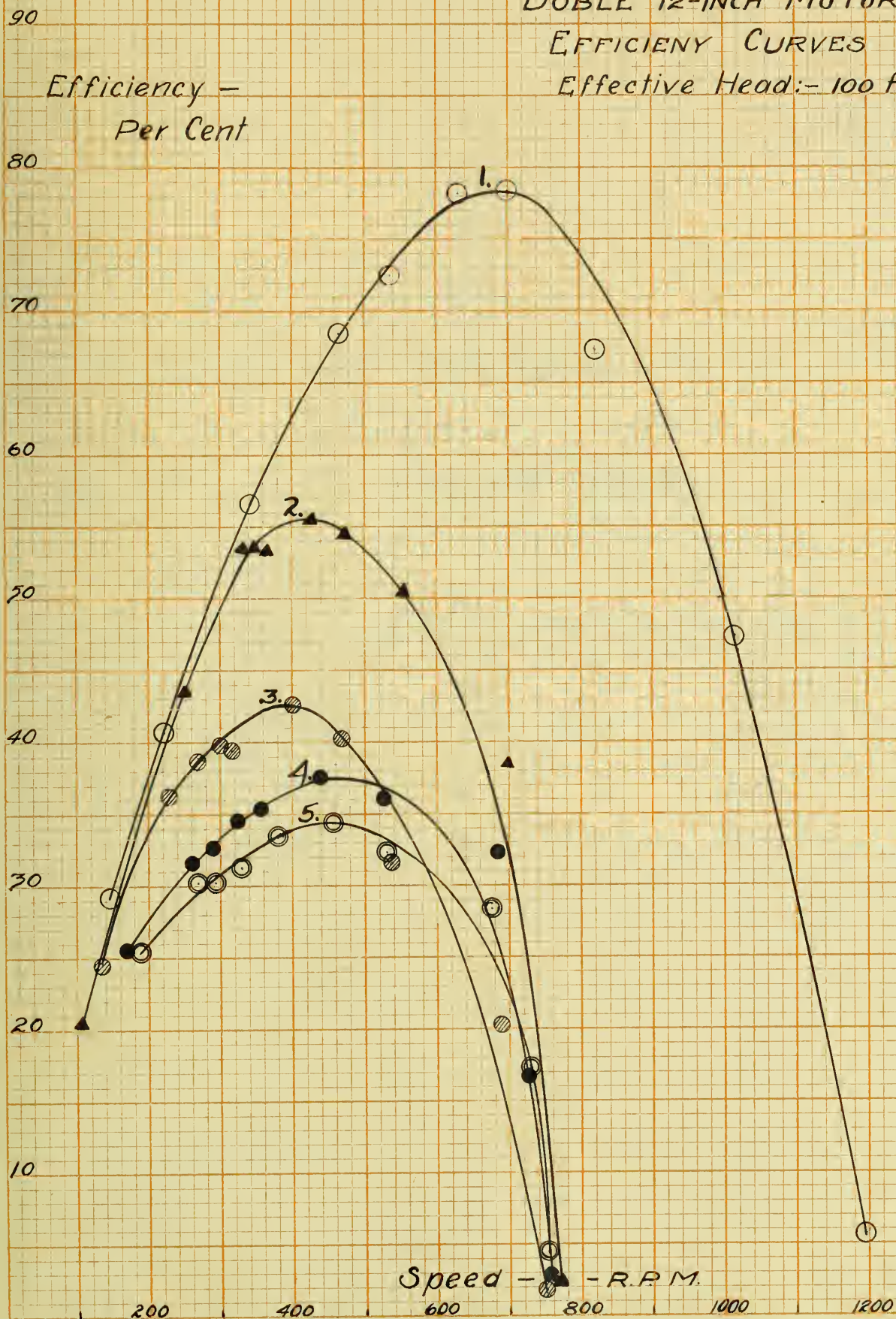
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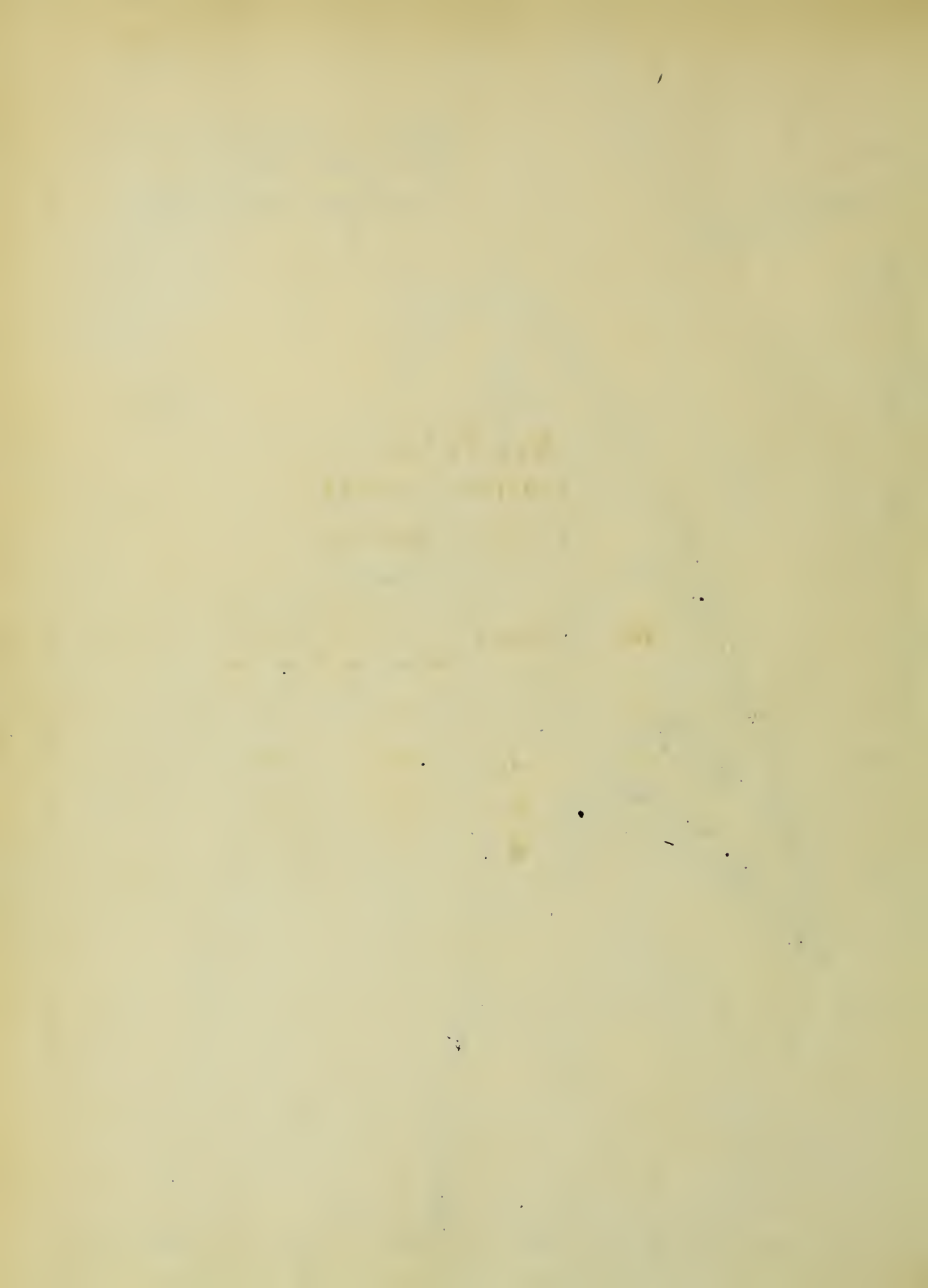
10





DOUBLE 12-INCH MOTOR
EFFICIENCY CURVES
Effective Head:- 100 ft.





Key To The
EFFICIENCY CURVES
PELTON MOTOR

| No. | Point | Orifice | |
|-----|-------|---------------|----------------|
| | | Diam. - in. | Area - sq. in. |
| 1 | ○ | $\frac{5}{8}$ | .307 |
| 2 | ▲ | $\frac{3}{4}$ | .442 |
| 3 | ⊗ | $\frac{7}{8}$ | .601 |
| 4 | ● | 1 | .785 |

PELTON 18-INCH MOTOR
EFFICIENCY CURVES
Effective Head: -20 ft.

Efficiency
Per Cent.

80

70

60

50

40

30

20

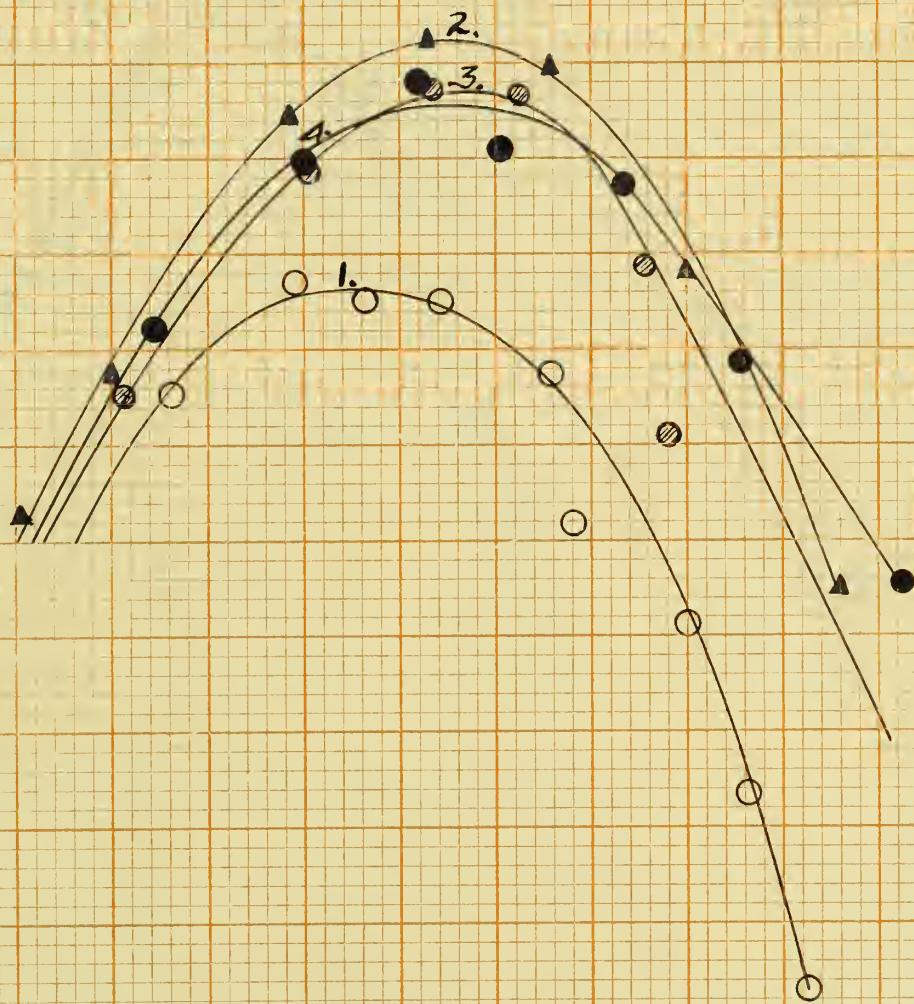
10

Speed - R.P.M.

100

200

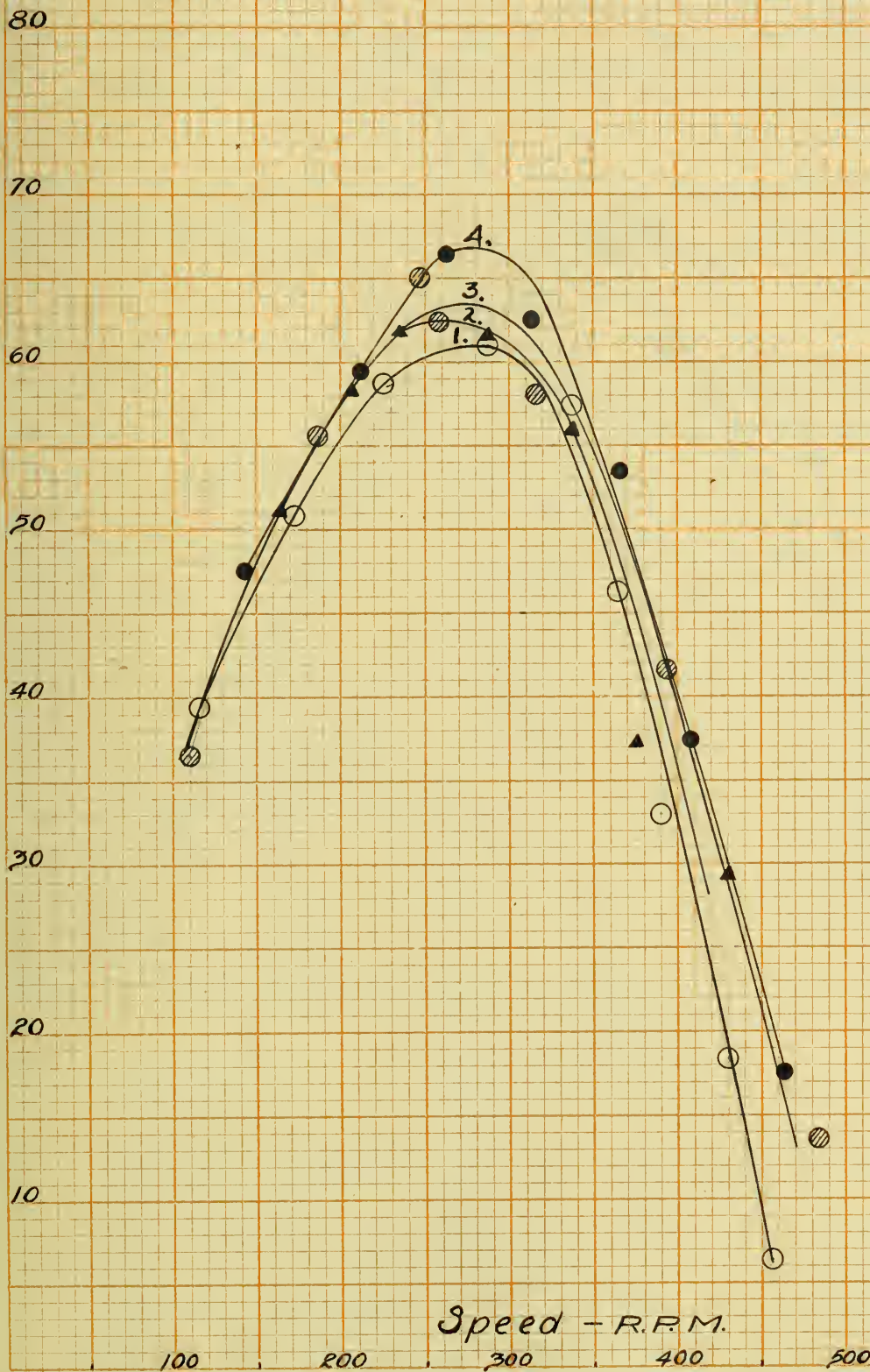
300





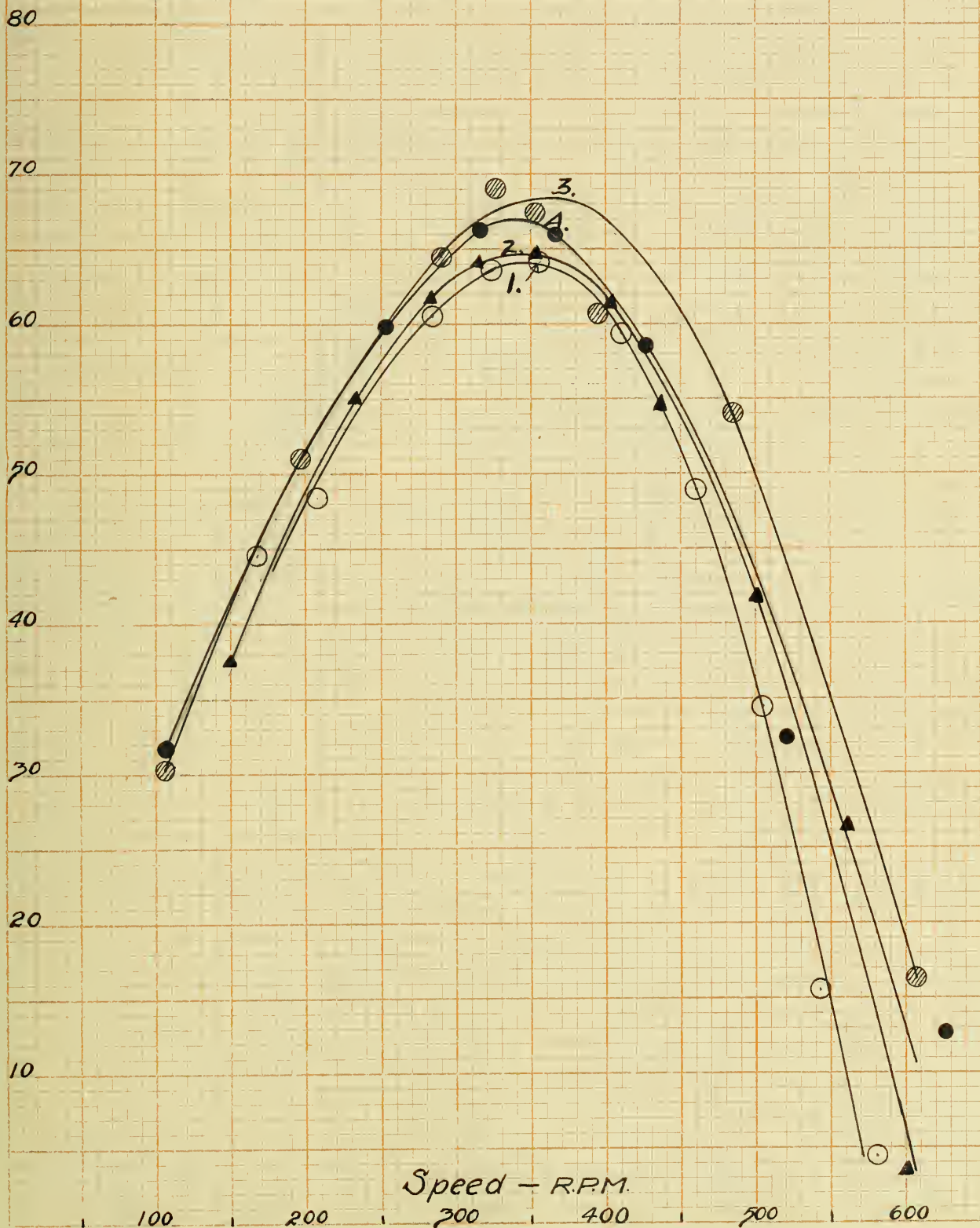
PELTON 18-INCH MOTOR
EFFICIENCY CURVES
Effective Head:- 40 ft.

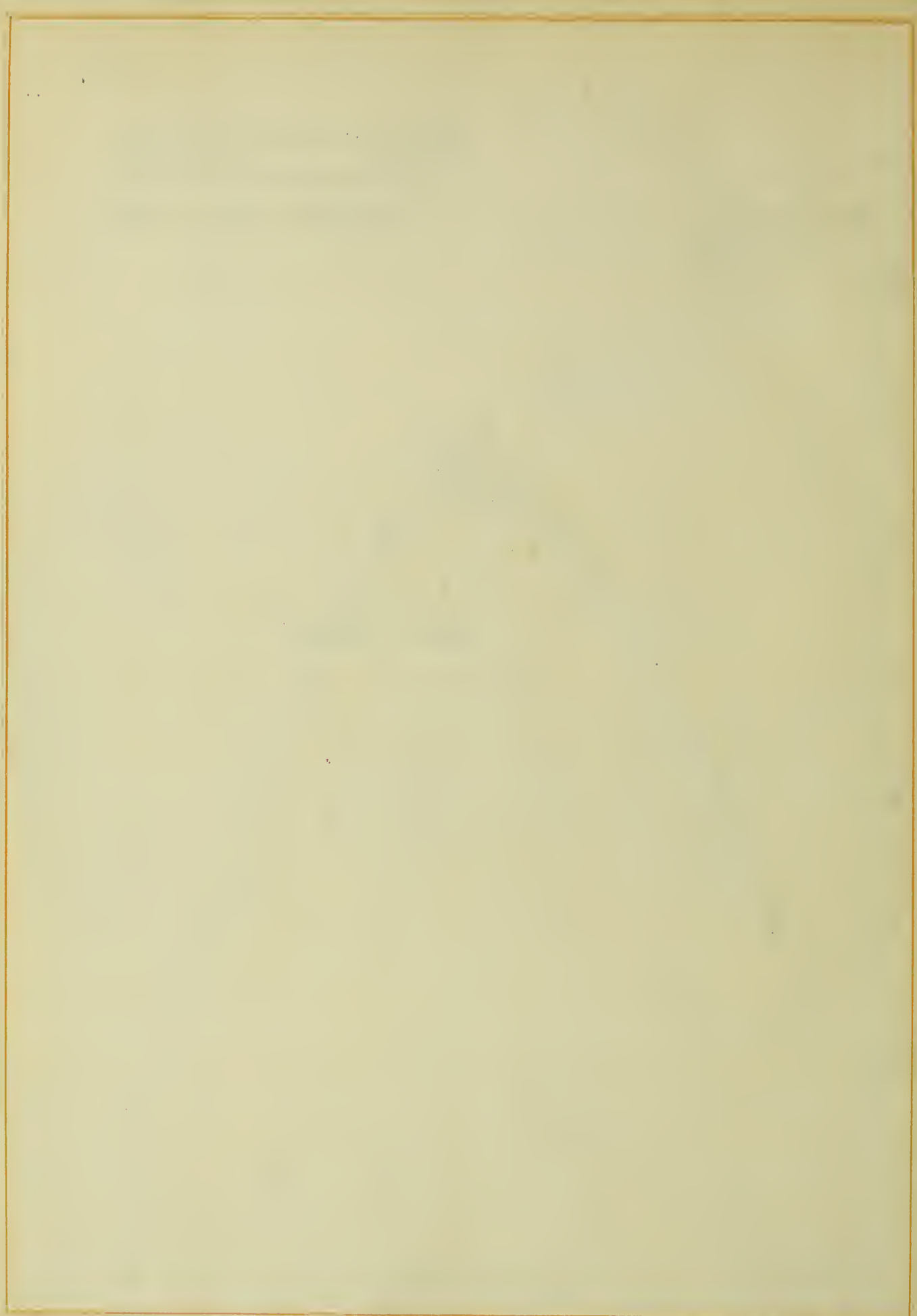
Efficiency -
Per Cent



PELTON 18-INCH MOTOR
EFFICIENCY CURVES
Effective Head:- 60 ft.

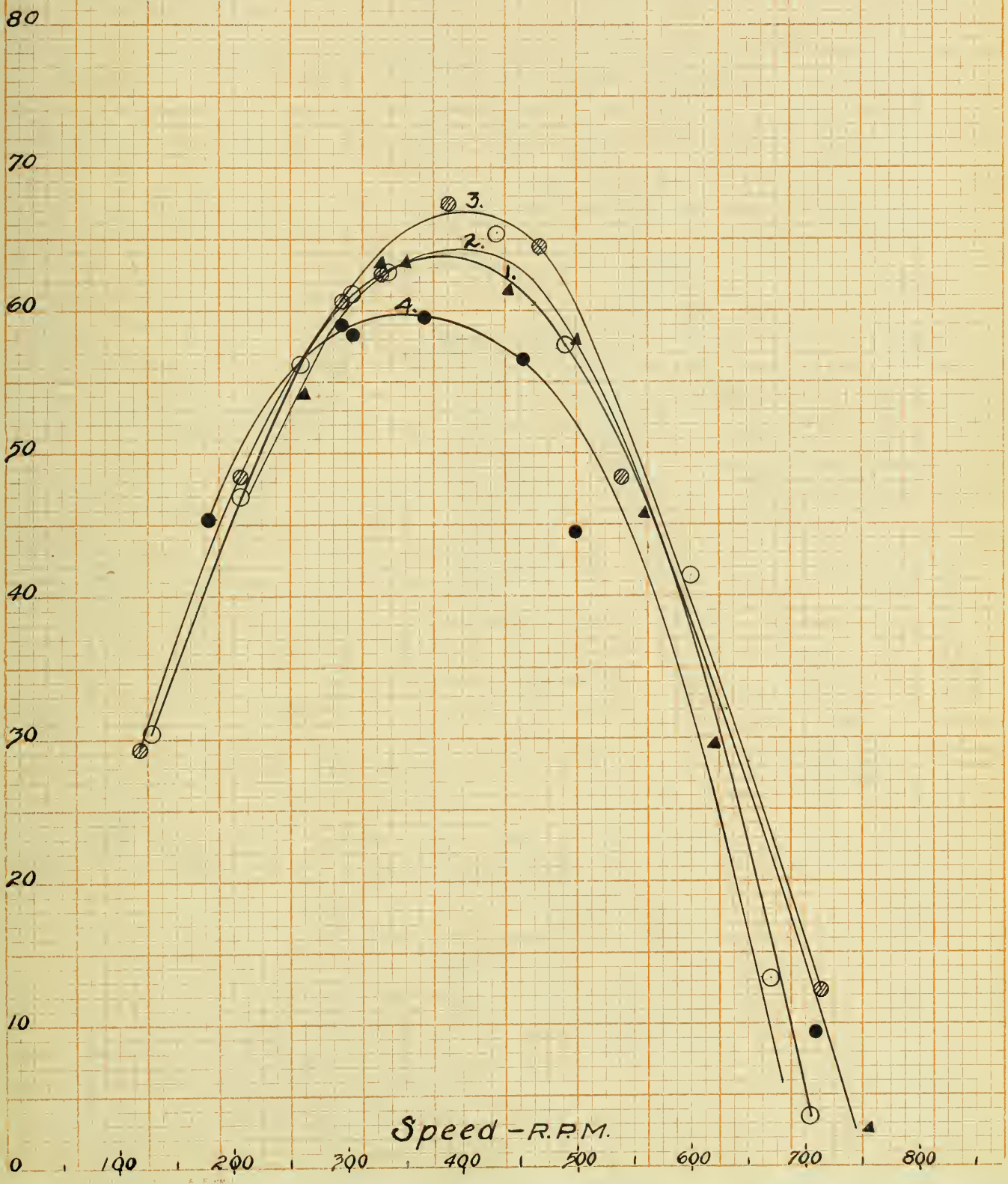
Efficiency -
Per Cent





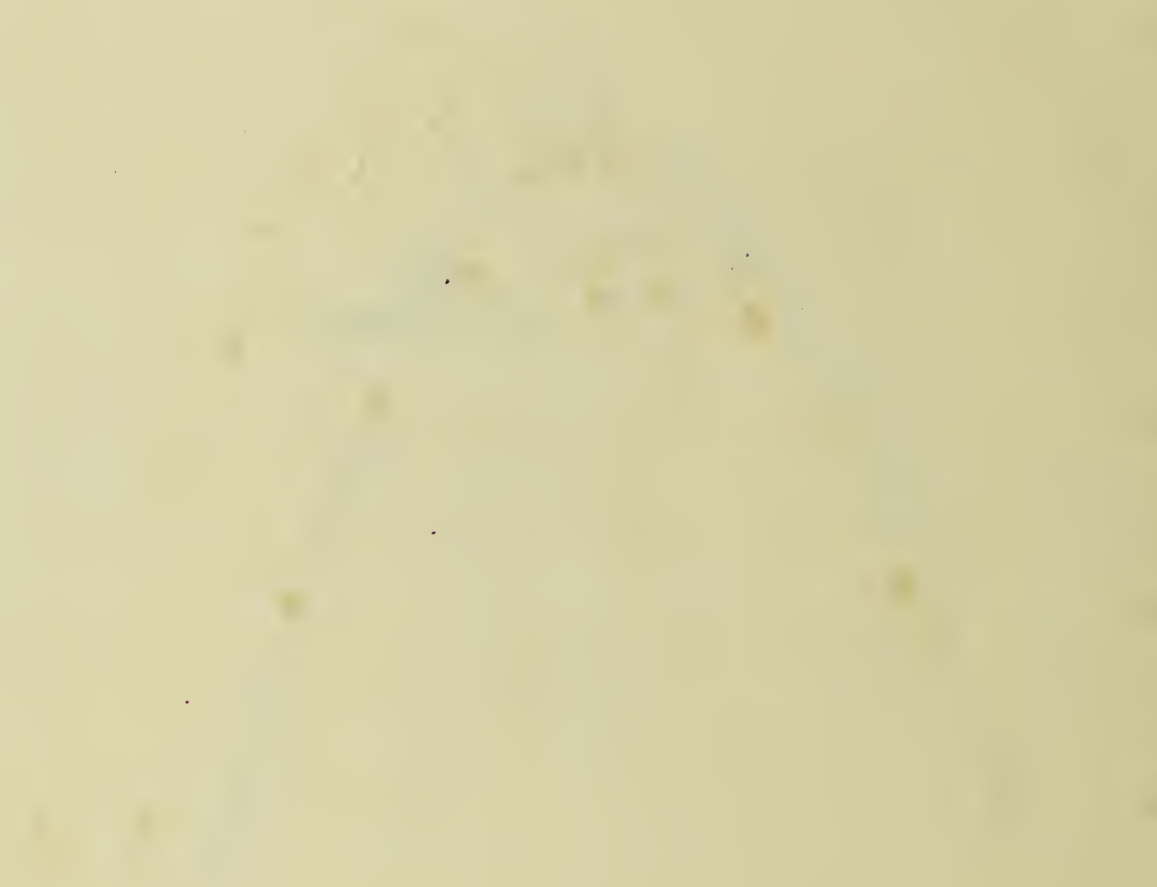
PELTON 18-INCH MOTOR
EFFICIENCY CURVES
Effective Head:- 80 ft.

Efficiency -
Per Cent

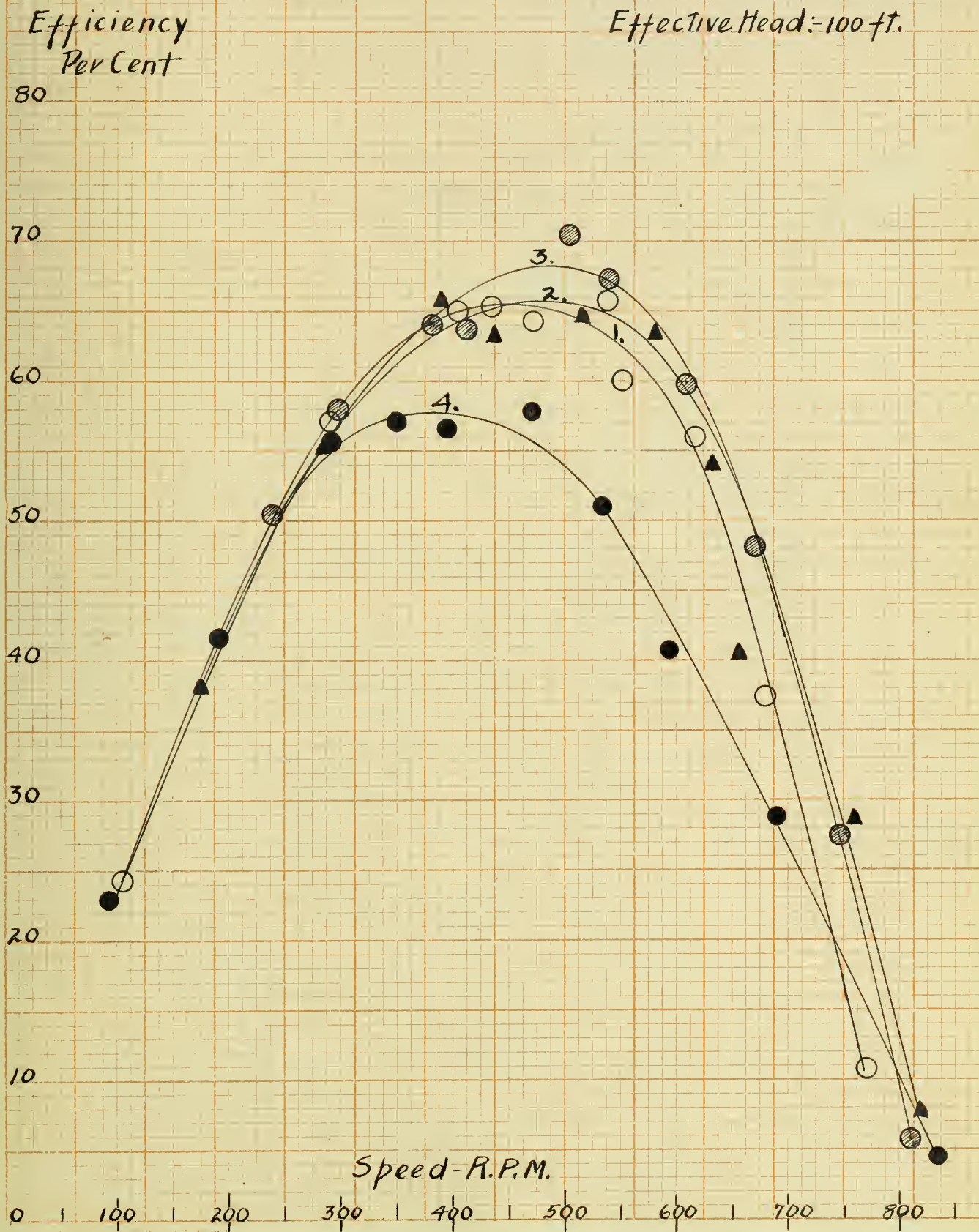


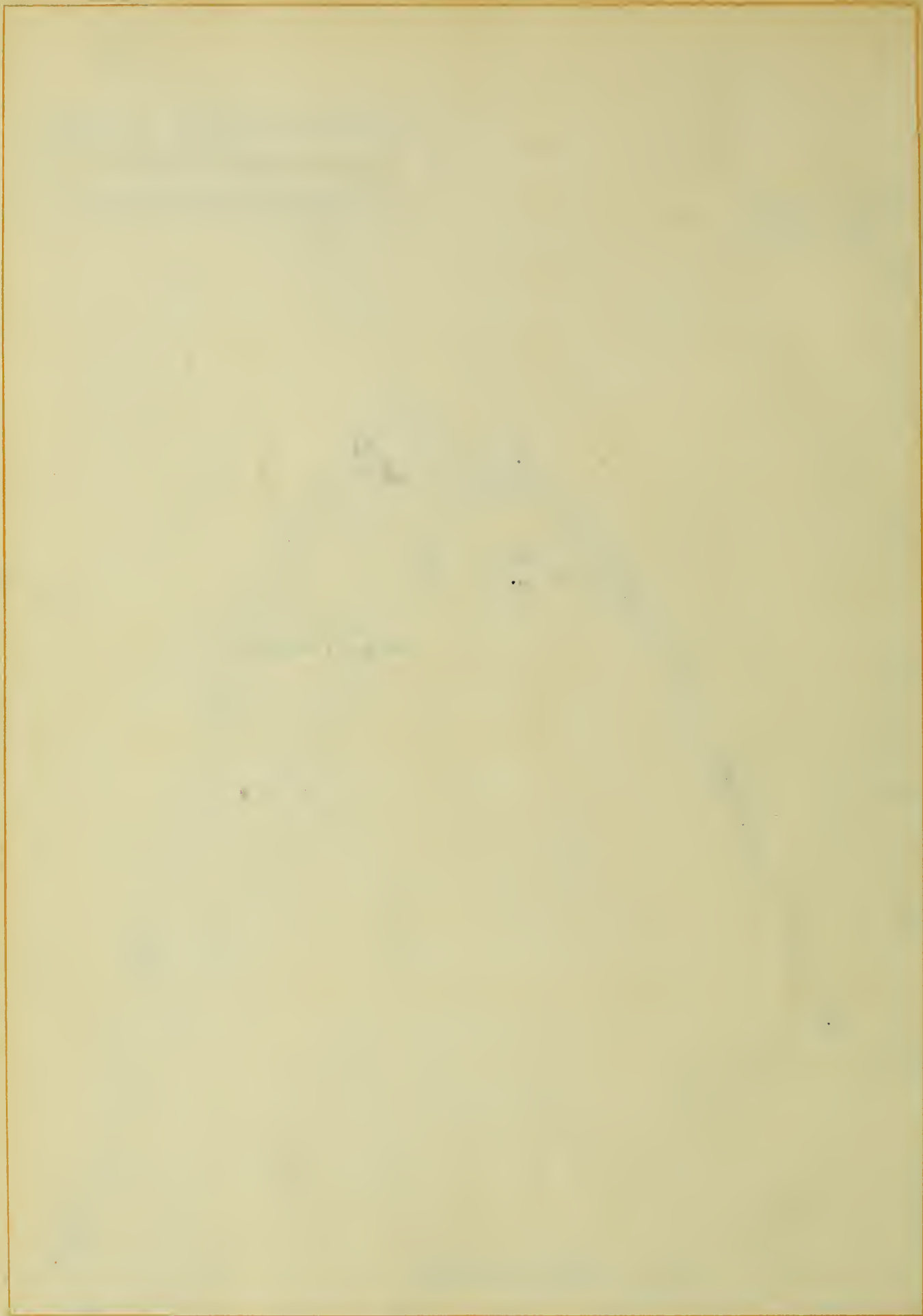
THE
LIBRARY OF THE
MUSEUM OF NATURAL HISTORY
AND
ZOOLOGY
OF THE
CITY OF BOSTON

1891



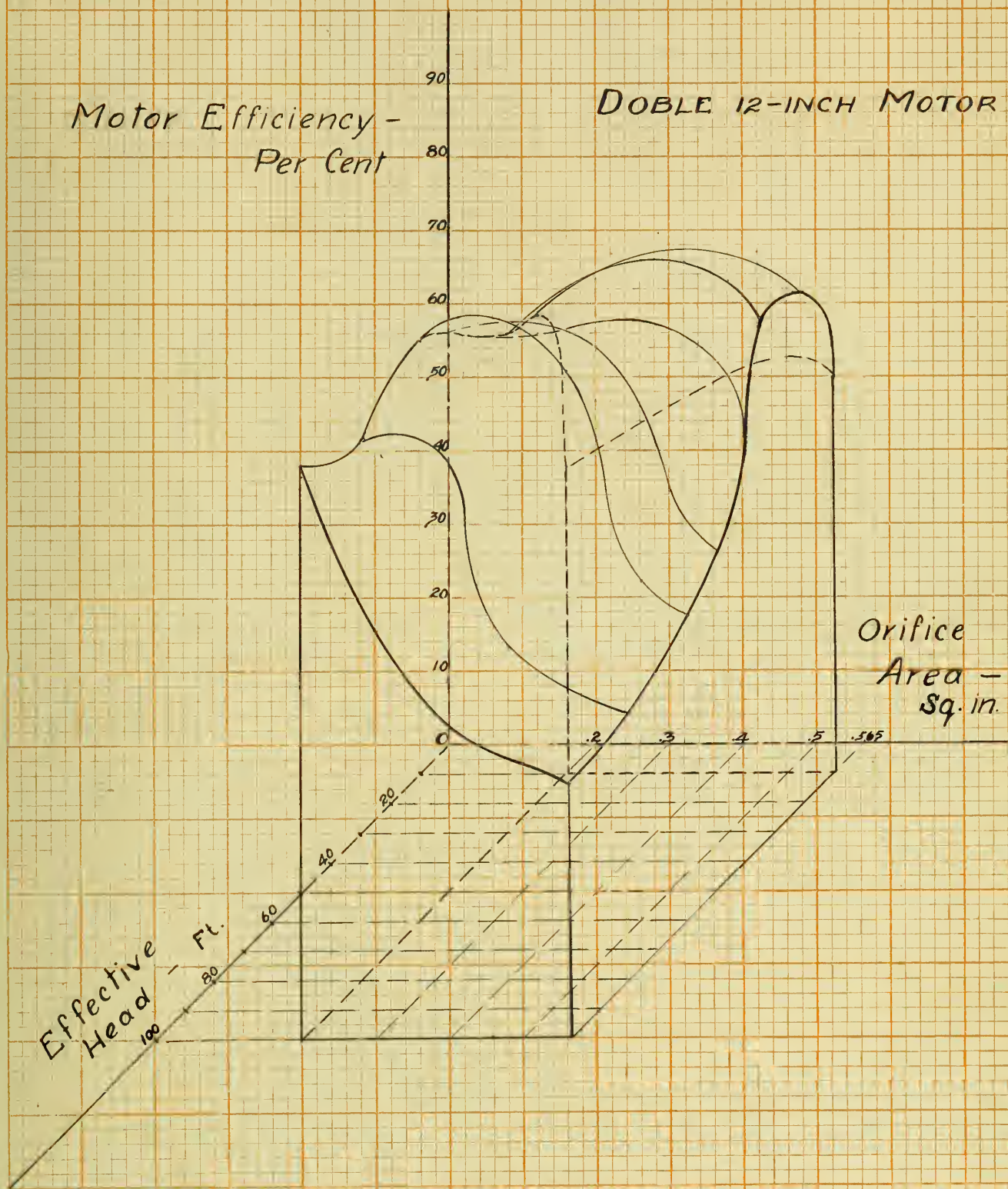
PELTON 18-INCH MOTOR
EFFICIENCY CURVES
Effective Head = 100 ft.





Motor Efficiency -
Per Cent

DOUBLE 12-INCH MOTOR

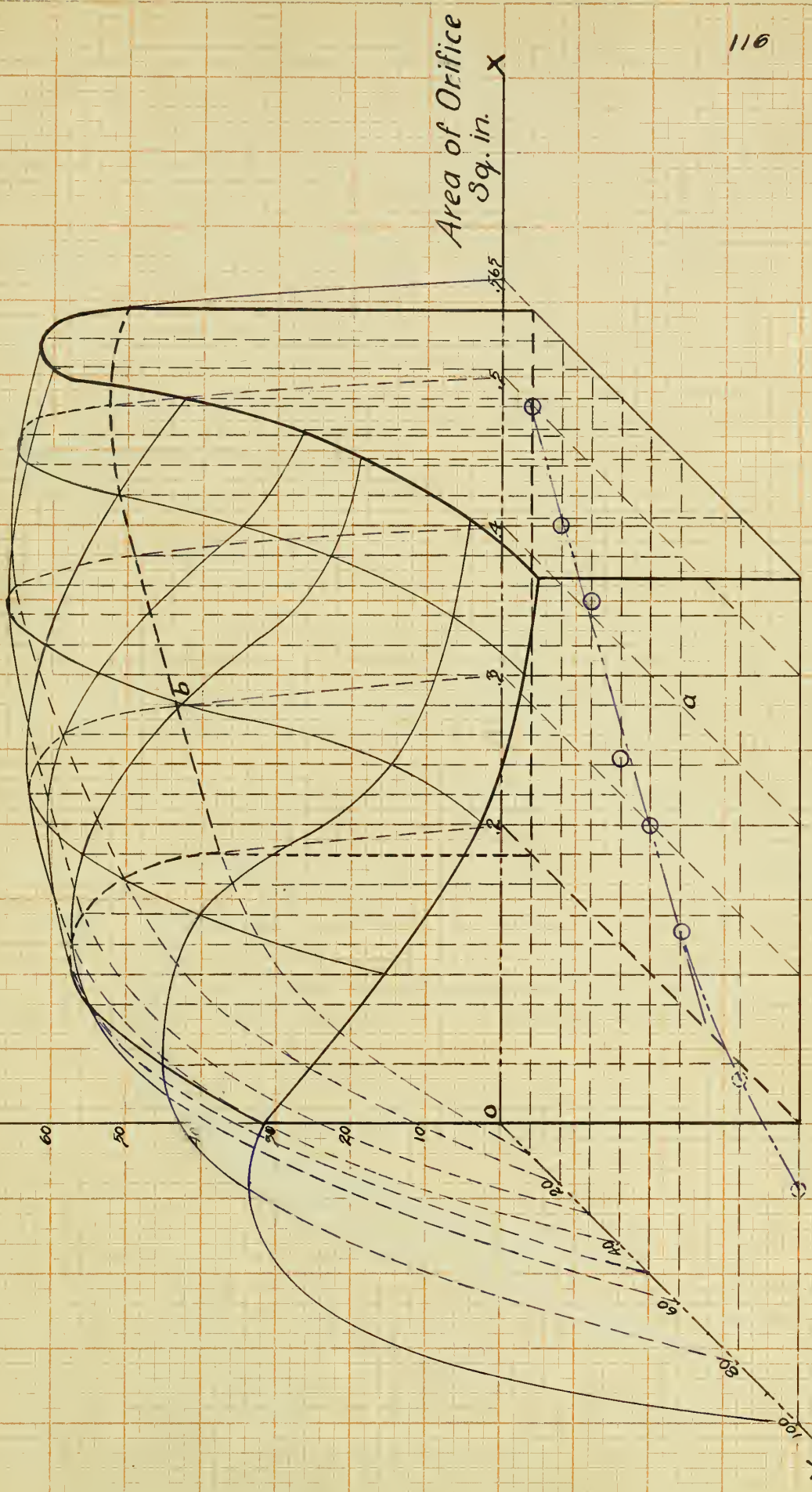


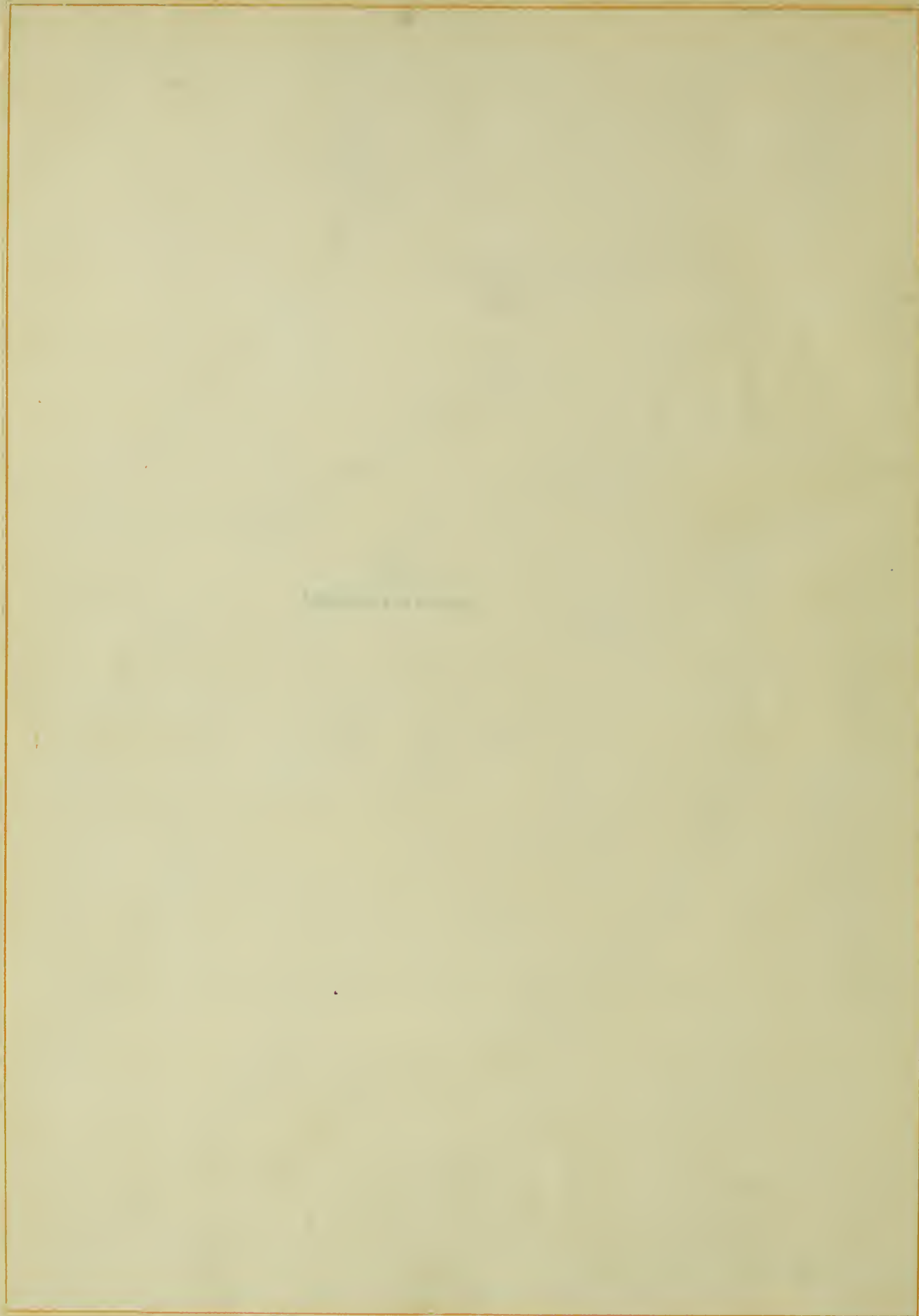
DOUBLE 12-INCH MOTOR

Z
Efficiency of Motor
Per Cent

Area of Orifice
Sq. in. X

Y
Effective Head - Ft.



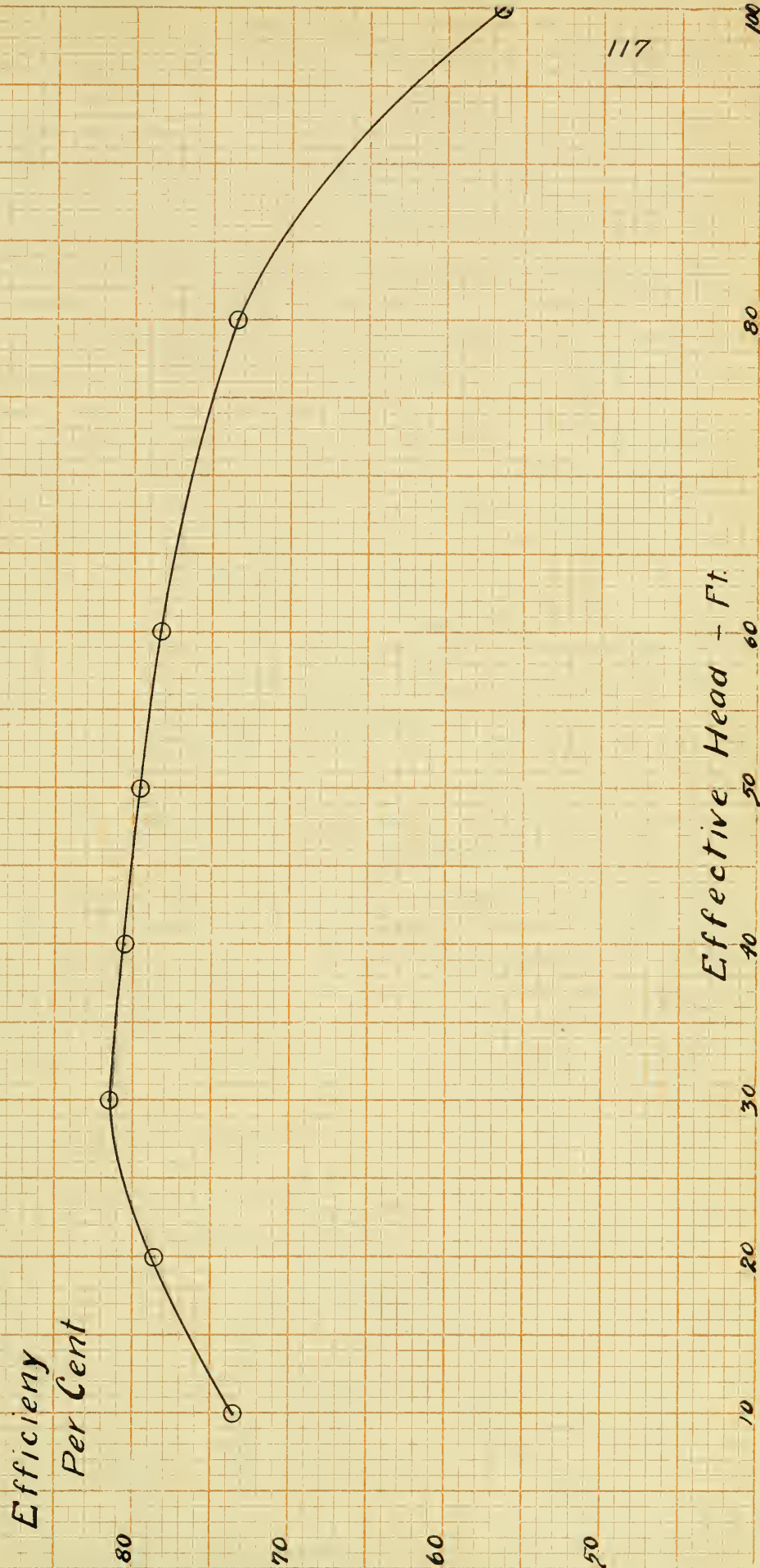


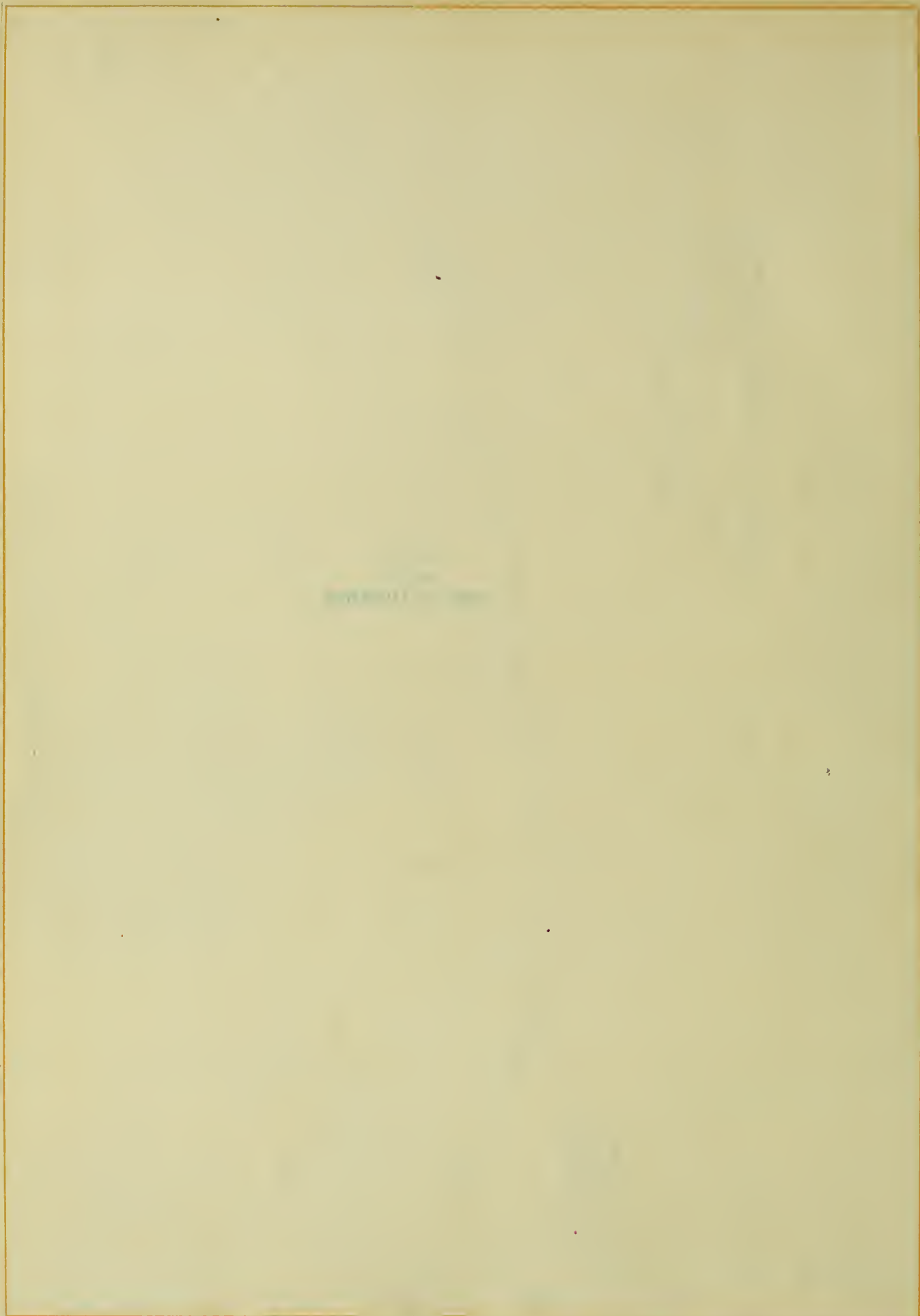
DOUBLE 12-INCH MOTOR
Curve of Maximum
Efficiencies

Efficiency
Per Cent

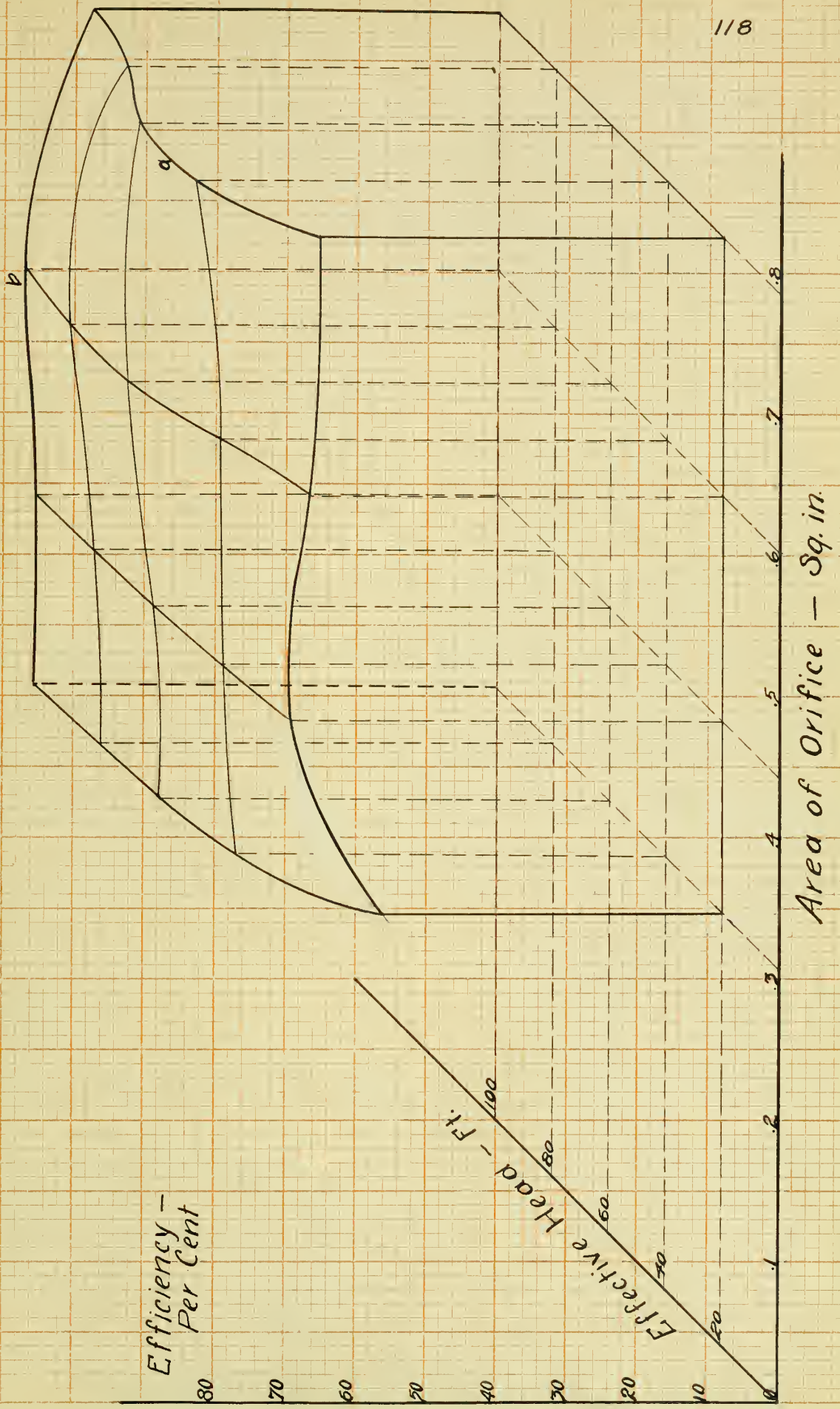
Effective Head - Ft.

117





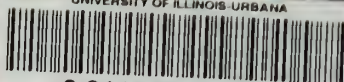
DELTON 18-INCH MOTOR







UNIVERSITY OF ILLINOIS-URBANA



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